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CHANGES for advertisements should be in this office by Friday noon for the following week's issue.

NEW ADVERTISEMENTS should be in the office not later than Monday noon to assure publication in that week's issue.

NORTHWESTERN ELECTRICAL ASSOCIATION CONVENTION.

The annual convention of the Northwestern Electrical Association was held at Milwaukee, Wis., last week. The meeting was eminently successful. The attendance was fair, and the papers presented were interesting and of much practical value. These were all discussed at length, a fact which went far toward making up for the neglect of the question box. This institution was not generally taken advantage of, but there was no lack of questions put and answered during the discussions.

The address of President Irving M. Lord was excellent. Mr. Lord took occasion to call attention to the tendency of municipalities to lay excessive taxes on electric light and power companies.

The influence of the Northwestern Electrical Association has grown steadily, and there is every reason to believe that it will advance to a still more important position under the present staff of officers.

THE MARCONI DINNER.

At the dinner in honor of Signor Marconi, given by the directors of the Marconi Wireless Telegraph Company of America last week, those who spoke seemed to agree that at no time since the first demonstration of wireless telegraph communication was there any doubt in the scientific mind of the ultimate successful and practical application of this method to the use of man. While considering the need and possibility of developing a selective system, Professor Michael I. Pupin said that the principle of tuning was but a practical application of one of the elemental laws which pervade all nature. Enlarging upon this idea, he called attention to the vast amount of energy which is poured out by the sun upon the surface of the earth on a summer day, and pointed out that this can only be utilized by those animal and vegetable lives which are in harmony with some elements of this. Whether the physical expression of this harmony be in color, texture or otherwise, this harmony must exist; otherwise, annihilation, or at least oblivion, would result.

The banquet was especially noteworthy as being in the nature of an illustration of the confidence now felt by the directors and engineers of the Marconi system for the complete and early establishment of wireless telegraphy on a commercial basis. This was the sentiment expressed for the directors by the toastmaster, ex-Attorney-General Griggs.

Signor Marconi took opportunity to express his gratitude and appreciation to the technical press of America of the intelligence and fair presentation which he had received since his earliest experiments. This, he added, was in strong contrast to the treatment of the electrical and scientific press of England and the Continent, inasmuch as those publications from the first had ridiculed the possibility of successful achievements in wireless telegraphy and had characterized his places for signaling and receiving as "thunder" stations.

THE INSTITUTE TELEPHONE MEETING.

The telephone meeting of the American Institute of Electrical Engineers, held last week, was one of the most interesting and successful of the exceptionally good series of meetings held during the fall and winter. The attendance was excellent, and served again to emphasize the need for a larger hall for these meetings. Many members were compelled to stand throughout the evening, and some were even unable to enter the room. The subject was introduced by Mr. Thomas D. Lockwood in an interesting paper on "The Evolution of the Telephone Switchboard." The modern telephone switchboard is the outcome of years of hard work and study, and, although a marvel of complexity, each part is so designed that it performs its function without interfering with others. Necessarily, in the development of these mechanisms many serious difficulties were encountered, and the telephone engineers certainly deserve credit for having attained so nearly to perfection as has already been done.

The reliability of the modern switchboard was strikingly brought out in the discussion following the paper. Mr. J. J. Carty stated that from records kept by the New York Telephone Company it was found that so surely did each part perform its work that the average interruption to service was only one hour and twenty-seven minutes in a year. Mr. E. F. Sherwood stated that with the modern switchboard not only is service much more reliable, but is also more prompt. The New York Telephone Company now has 53,000 lines, operating nearly 92,000 stations, with calls averaging nearly 550,000 per day. Yet in handling all this vast business, the average number of complaints was less than four per day, or, as he strikingly put it, one complaint for each station in forty-one years. It would certainly seem difficult for any business to show a better record than this; but we have no reason to believe that the limit

for reliability has yet been reached. These figures certainly argue well for electrical mechanisms, and should go far to dispelling that feeling of doubt which still lingers with some engineers toward electrical appliances. We doubt if any railroad signaling system can show a record which equals this, and we believe that the telephone will certainly find a much wider use in railway operation.

As was pointed out in the discussion, the telephone engineer is under the necessity of installing at every station apparatus suitable for conversing over long-distance lines, and doubtless the careful work which must be done to meet this requirement has helped materially in adding to the reliability of the system.

The points brought out by Mr. B. Gherardi, Jr., were very instructive, indicating the many different classes of work which the telephone engineer must be ready to handle, covering practically the whole field of electrical engineering. These remarks were very timely, as probably the majority of students in engineering courses rather belittle telephone engineering. It is a question which is the more difficult problem—high-tension transmission or telephone transmission. Although the latter has not the dangers and troubles of high voltages to contend with, it is so restricted in other ways, and the necessity for preventing all interferences from every source adds much to the difficulties of the solution.

Another interesting and instructive point brought out during the discussion was the method now adopted by some of the larger companies for obtaining their employés. Telephone schools have been established, through which every operator must pass. Every one to-day will admit that this is the only proper way. In telephone operation, reliability is a prime factor, and this must certainly be seriously affected if untrained operators are allowed to practice on the public.

On the whole, it would have been hard to improve upon this meeting. The interest of all was held throughout the evening, and the papers and discussion form a noteworthy addition to telephonic literature.

CAR STOPS.

In practically all the large cities of this country the public is clamoring for better street car service. Attention has been called to the causes of interference with the movement of the cars, and numerous suggestions have been made with the hope of improving the present service. Double-deck cars have been suggested, with the hope of increasing the car capacity. The delays caused by trucks and other vehicles have received attention, as well as other disturbing factors.

Recently a plan was suggested, which is the outcome of a discussion of another phase of railway operation, and which is outlined in the current number of the *Tramway and Railway World,* London. In this journal Mr. R. W. Western undertakes the determination of the loss and cost involved in stopping a street car. These losses consist of several factors which may properly be charged against the stop. They are loss of energy and the loss of earning capacity of the car, since its daily mileage is shortened by the time lost during the stoppages. Another important item, which does not affect the railway company except in so far as it detracts from the service, is loss of time to the passengers on the car, caused by the stoppages.

Mr. Western considers these various factors, and secures some interesting and instructive data. He finds that the loss of energy caused by the average stop on an average road is equal to one-fourteenth of that required to run the car one mile. It is more difficult to determine the loss in earning capacity, as so much depends upon the local conditions. The author thinks that the most objectionable feature of frequent stops is the loss of time caused to others already on the car.

It is suggested that the railway company abandons the practice of stopping at every crossing, and make stops only at, say, every third or fourth street. The loss of time caused to any passenger by his having to walk a further distance to the stopping point would in most cases be more than made up by the time saved due to the less frequent stopping during the time he was on the car. This proposition seems to have some truth in it, and, excepting the doing away with the interference caused by trucks, would seem to be the only practical way of increasing the average speed of a surface car. At the present time it is not probable that higher maximum speeds will be allowed in the streets. In addition to the time saved, the comfort of the passengers would be much promoted, particularly in the large cities where the necessity for quick acceleration has brought about the adoption of large motors. It is a common practice for the motorman to start the car as rapidly as he dare, and the effect on the passengers is anything but agreeable.

It is hardly probable that the system would work out in practice as prettily as it does on paper, since much obstruction at the cross streets must be expected; but even though the car were compelled to slow down, there would still be a saving due to the avoidance of an actual stop.

The author, anticipating some objection to this system, particularly from those unfortunate enough to have to walk one or two squares further to board the car, suggests that a discriminating fare might be adopted, charging a minimum for passengers who ride between regular stoppages, and something more for those who require a stop at other points. This scheme seems impracticable. However, the improvement which would result from a decrease in the number of stops would be appreciable. A trial of this plan of operation, we think, would prove a source of much discussion as well as opposition in congested Broadway, for instance, where thousands of passengers daily ride only a few blocks.

The correspondence which has come to the editorial rooms of the ELECTRICAL REVIEW during the past ten days, especially from writers representing manufacturing interests, indicates that the construction of new work and reconstruction of old systems will be greater during the approaching season of spring activities than have ever been known in the history of the electrical industry. This is especially noteworthy in connection with street railways, electric lighting plants and telephone exchanges.

ELECTRICAL MINING NOTES.

COAL CUTTING BY ELECTRICITY IN BRITISH MINES—I.

WHAT IS MEANT BY COAL CUTTING?

Perhaps it will be as well to explain what is meant by coal cutting. In mining papers it is often referred to as kirving. A better term is undercutting. This latter term exactly expresses what is done, and what a machine for cutting coal has to do. Coal lies in beds, spread out like a thick sheet, or the dough of a pudding, but following the contour of the outside of an irregular basin. The coal seams have been developed from vegetation, which has grown in lake basins, which has died and been buried, and upon which successive layers of strata have been deposited, the seam gradually forming into coal, but following the surface inside of the basin in which it was formed. Thus, all round the basin it outcrops, as it is termed, the edge of the seam comes to the surface. From the edge it gradually descends, at a decreasing inclination, till at the bottom of the basin it is nearly flat. The seams so formed are pressed between the strata upon which they lie, and those which have been deposited upon them, and in order that the coal can be removed from its bed it must be dislodged from both of these. It will be understood that the continuous pressure of ages sets up a certain amount of cohesion between the coal and the strata above and below it. Its dislodgment is accomplished by cutting a groove under the coal, sometimes in the underlying strata, sometimes in the coal seam itself, sometimes partly in both. The groove is cut in to a certain distance, and the coal is forced away from the strata above it by blasting, wedging, or by the natural leverage of the weight of the coal itself. The groove which is cut underneath it provides space for the coal to come down, away from the strata above, usually breaking up in the process of falling.

HOW THE MINER UNDERCUTS.

The miner undercuts or kirves, as it is termed in some districts, by picking away the coal, or the clay which usually lies under the coal, with the point of his pick, a very little piece at a time, till he has carried the cut to the required distance under the seam. But in order to carry the cut in to the required distance, which varies from three feet up to six feet, he has to cut away a sufficient quantity of the coal itself to allow of his body passing in under the coal to get at the inner part of the cut, so that he cuts not a groove, but a space whose section is that of an irregular right-angled triangle. The coal-cutting machine, on the other hand, cuts a parallel groove, only four to five inches in height, but to the required depth. Incidentally, this gives most of the coal owners a distinct advantage, as a smaller amount of the coal is made into slack, which has a very much lower value than round coal or lumps.

THE MACHINES USED IN UNDERCUTTING.

There are three electrically driven coal-cutting machines in use in this country (England), one known as the chain header, which is used only for driving headings, the others the disc and the bar machines, to which must be added the recently introduced jib machine of the Morgan Gardner Company.

THE HEADING MACHINE.

This is used in opening out the colliery, driving roads for the haulage, etc. The only two heading machines driven by electricity in use in the United Kingdom are the Jeffrey and the Morgan Gardner, both American machines, and both well known in America. The arrangement of each is very similar. A moving platform or frame is supported on the body of the machine in such a manner that it can be moved out in one direction, horizontally, and withdrawn. The moving frame has a chain running around it in a space provided for it, the chain carrying cutting chisel-shaped tools which cut the coal or the strata underneath, bringing it out with them, and leaving a groove four or five inches in height. The width of the frame is usually only about three inches or less, so that undercutting is accomplished by a succession of cuts. The machine is run up to the face of the coal, the frame is pushed out against the coal; the chain is run, it cuts its way in to the depth desired, the frame carrying the chain is then run back, the machine moved across the face the width of the cut made, so as to commence a new cut where the last cut finished; the frame is then run out again, a fresh cut made, and so on. The motion of the frame in its bed and of the chain around the frame is derived, in electrically driven machines, from an electric motor, through spur and beveled gearing. The motor is also arranged to furnish power to drive the machine itself from place to place when the latter is mounted on a wheeled truck provided for the purpose. The horse-power of the motor provided with the chain breast machine is now usually nominally twenty-five horse-power, but is capable of performing more work, if required, for a short time. The power usually absorbed does not often exceed twelve horse-power, but it is sometimes necessary to exceed this very considerably, on account of the possibility of meeting with nodules of iron pyrites embedded in the coal and in the underlying clay.

THE ELECTRIC LONG-WALL MACHINES.

The largest number of machines used in this country for undercutting the coal are for long-wall working. Perhaps it will be as well to explain.

THE TWO SYSTEMS OF WORKING BRITISH COLLIERIES.

There are two principal systems of working the coal, removing it from its bed, in the United Kingdom, the long-wall, and what is called, according to the locality, "bord and pillar," "stoop and room," and other names. The "bord and pillar" system is the older, and for many seams the easier method of getting the coal. It is the system in use almost universally in America. It consists in cutting passages in the coal, at right angles to each other, from the neighborhood of the shafts to the boundary, forming the seam into a sort of checker-board. The pieces left between the passages are the "pillars," and the "bord" is one face of the coal seam. The passages referred to are cut in the seam on a regular system, working outward, as it is called. That is to say, passage after passage is made till the boundary of the area covered by the lease is reached in every direction. Then working back, as it is called, commences, in which operation the pillars which were left on the outward working are taken out. The passages between the pillars are often not more than eight feet wide, so that only machines of the type of the chain breast machine, or something on similar lines, can be used.

LONG-WALL WORKING.

In long-wall working, a long face is taken, ranging from 100 yards long up to 900 yards, and in a few cases to 1,200 yards, and this face moves steadily forward, the whole of the coal being removed as it advances. It was the necessity for working the thin seams which produced the necessity for working on the long-wall system, as the "bord and pillar" method could not be employed economically with seams of less than a certain thickness. In long-wall working, the coal-cutting machine works right along the face whatever length it may have from day to day, the usual plan being to cut the coal, that is, to undercut it during the night shift, and to fill it into wagons and get it to the surface during the day. In some of the large collieries in Yorkshire and Derbyshire, there are as many as twenty machines working in a single colliery, each machine cutting across a face of from 900 yards upward. When the machine comes to the end of its face it either cuts back along the face in the reverse direction, or is moved round to where it commenced, and again commences to cut across the face.

Northwestern Electrical Association.

Proceedings of the Eleventh Annual Convention, Held at the Hotel Pfister, Milwaukee, Wis., Wednesday, Thursday and Friday, January 21, 22 and 23, 1903.

THE eleventh annual convention of the Northwestern Electrical Association, held at Milwaukee, Wis., in the comfortable and commodious Hotel Pfister, January 21, 22 and 23, while the attendance failed to reach expectations, what was lacking in numbers was more than counterbalanced by enthusiasm. In every way was the gathering most interesting and noteworthy, and the reputation worthily gained for forceful vigor in furthering the needs of both its members and the public was thus more thoroughly maintained.

An excellent programme had been arranged, the few papers were wisely selected and not carried to excess in number, as is frequently the case, while the intervening hours between the meetings were enjoyed by all as an opportunity to meet old friends and form new and agreeable acquaintances. On the Wednesday evening a theatre party of the entire convention enjoyed the light and bright variety entertainment offered at the Olympic Theatre, and on the Thursday the usual banquet and its accompanying short speeches took place.

WEDNESDAY'S SESSION.

The convention was called to order at 11.30 A. M. Wednesday by President Lord, when the following programme was announced:

Wednesday—Morning session—Convene at 11.30. Roll-call; reading of minutes; president's address; secretary-treasurer's report. Afternoon session—Appointment of nominating and membership committees; applications for membership; reports of all committees except nominating; miscellaneous business. Paper, "The Economic Value of Testing," Professor G. D. Shepardson, Minnesota; paper, "Metal Preservation," Professor A. H. Sabin, New York. Evening—Theatre party. Assemble in Convention Hall at 7.30 and proceed in body to the selected theatre.

Thursday—Morning session—Questions and answers. Paper, "Rates and Methods of Charging," J. W. Shuster, Wisconsin; paper, "Association History," Thos. R. Mercein, Milwaukee. Afternoon session—Report of nominating committee and election of officers. Paper, "Automatic Voltage Regulation," H. C. Wirt, New York; illustrated lecture, "Light and Modern Illumination," W. D. Ryan, Chicago. Evening—Annual banquet at 8.30; assemble in Convention Hall at 8.15; promptness requested.

Friday morning—Unfinished business. Adjournment.

Roll-call and reading of minutes were dispensed with, as the printed minutes had been sent to all members.

The president then read his address, an abstract of which follows:

To the members of the Northwestern Electrical Association:

Gentlemen:

It is with pleasure that I greet you at this the tenth annual meeting of the Northwestern Electrical Association. I am pleased to see you all, individually and collectively. . . . The year just closed has been one of unusual prosperity with all industries, and I do not think that the electrical business has been any exception. I can speak somewhat intelligently as to the prosperity of the central station men, as I have talked with a good many of them, and all seem to report a successful year. We find that we have been obliged to pay rather more for our new electrical machinery and supplies than we paid three or four years ago, but even with this pleasant little jolt our increased incomes have been such that our net profits at the close of the year have been somewhat in excess of previous years. Our labor account has also been larger, as it has cost our employés more to live, and necessarily they were entitled to an increase of wages. The merchants, and inhabitants generally, are finding that electricity produces the best light on the market, and while it costs more than other kinds, it is worth more. I think that the people are being surely educated to the use of electric lights, and that even in the small cities plants which have in times past had a hard struggle will eventually be placed upon a paying basis, and will return at least a fair rate of interest on the investment.

One thing that I wish especially to call the attention of central station men to, is the tendency of state legislatures to place exorbitant taxes upon electric lighting plants. I do not think that this is really the intention of the members of the legislature, but there seems to be a large demand from the people in general for increased taxation along certain lines, and especially upon corporate interests. It is probably unfortunate that most electric lighting plants are owned by corporations, for I really think that were these properties owned by individuals, they would not be placed in the same classification with railway companies, express companies, street railway companies, and the like, against which there now exists a manufactured prejudice. There are already hundreds of thousands of dollars invested in electric lighting plants in the state of Wisconsin, and every year witnesses the installation of new ones and the betterment of old ones. Unless the owners can receive a fair rate of interest upon their investment, progress in this line will be slow. In case taxation become exorbitant, it will be necessary for the companies to charge the consumers higher prices for current, and this would be a hardship to many, and absolutely prevent some from using it at all.

I wish to say one thing at this time to central station men regarding the use of meters, and I am speaking from a personal experience. The Waupaca Electric Light and Railway Company—with which I am connected—until the beginning of 1902, sold current by monthly contract, and the result was that consumers wasted more than they of necessity used. Our machines were being crowded beyond their capacity, and we were confronted with the necessity of installing more machines, or declining proffered business. To obviate this, we began installing meters, and I am pleased to say that the result has proven very satisfactory. Since we put in the meters our load, especially after 11 P. M., has been reduced fully sixty per cent, and during the earlier part of the evening from thirty to forty per cent, while the gross income of the company has been increased about twelve and one-half per cent. Were we running entirely by steam, this would make a very desirable showing as a business proposition. I can not too urgently recommend to central station men the benefits that will accrue by the installation of meters, and the doing away of the old contract method of selling electric current so prevalent in smaller cities. It will increase the capacity of your plant, it will increase your income and it will decrease the amount of your operating expenses.

After the statement of the financial condition of the association, the secretary and treasurer's report is as follows:

In April last I went to Europe on a two months' combined business and pleasure trip, and arranged with Mr. James Wolff to take charge of the secretarial work during my absence, and I beg to acknowledge here my obligations to him for his willing, faithful and efficient service. In June the summer convention was held at Waupaca, Wis., in connection with the Wisconsin Independent Telephone Association. The joint convention did not bring out the number hoped for, but as a summer outing the meeting was very enjoyable and successful. The usual two notices of this convention were mailed to all members, and in addition thereto the transportation committee, Messrs.

Wolff, Low and Whyte, have stimulated the members with attractive prose and poetical postals. Both the association and its secretary are under obligations to these gentlemen for their energetic and efficient work. The plan of printing convention papers in advance having apparently met with your approval, I consider the extra expense warranted, and have continued the plan this year.

Respectfully submitted,
THOMAS R. MERCEIN,
Secretary and Treasurer.

Milwaukee, Wis., January 20.

A recess was then taken until two o'clock in the afternoon, when the convention was again called to order by the president.

President—Gentlemen, please come to order. We have requested that the supply men simply close their doors at the opening of the session and keep them closed for a short time at least, so that the members and others will be more prompt in appearing at the sessions. There will be plenty of time to visit the supply rooms, even if we attend to our meetings as we ought to. Now, the time has arrived for opening this afternoon session, and the first thing is the appointment of nominating and membership committees. The nominating committee will not report until the afternoon session to-morrow. The membership committee is expected to look over the applications for membership and to report upon them. I will appoint on the nominating committee the following:

Mr. John H. Harding, of La Porte, Ind.; Mr. E. P. Maxwell, of Dixon, Ill.; Mr. H. F. Pearce, of Negaunee, Mich.

On the membership committee I will appoint the following: Mr. H. J. Gille, of St. Paul; Mr. O. B. Williams, of Whitewater, and Mr. P. H. Korst, of Janesville, Wis.

President—The next thing is reports of all committees except nominating committee.

The secretary then read a letter from the chairman of the legislative committee, Mr. S. B. Livermore. The report stated that the Governor of Michigan had recommended to the legislature that the tax commissioners have their powers enlarged and be made the final one to equalize in the state. In Indiana there were no bills before the state legislature affecting the electrical business. In Minnesota a special session of the legislature was held during the months of January and February, 1902. The principal bill introduced at this session was one regarding taxation. It was proposed to levy a tax upon the stocks and bonds and then find the value of the franchise by adding together the face value of the stock and bonds, and from this sum the cash value of the entire personal property is subtracted, the remainder to be assumed to represent the value of the franchise. In other words, it was proposed to tax the total issue of stocks and bonds of all electric companies at their face value. A great fight was put up against this proposition by the electric interests of the state, and, after a hard fight, the bill was defeated. At the present session of the legislature a bill has been introduced authorizing the tax of public service franchises either on the basis of property or gross earnings. The tax to be apportioned among the state, the counties and the municipalities where the franchise is exercised, and in the same manner that real estate taxes are apportioned. No information was received from Wisconsin, Iowa and Illinois.

The committee appointed at the last January meeting of the association to report on "Uniform Advertising" then submitted the report. This report was followed by a lengthy discussion by H. Almert, of Chicago; George Cutter, of Chicago, and Messrs. Gille, Grover, Bowen and Barron.

The following applications, which had been filed with the committee on membership, were reported favorably and unanimously elected:

The Osborn-Morgan Company, manufacturer of arc lamps, Cleveland, Ohio.

Roger U. Kimball, vice-president and superintendent Kenosha Gas and Electric Company, Kenosha, Wis.

A. W. Crabe, electrical engineer Plankington Estate, Milwaukee, Wis.

Correspondence between the secretary and the American Institute of Electrical Engineers and also a report of joint committee was taken up and action thereon deferred until Thursday.

The secretary then read a communication from Mr. Doherty, who was unable to be present.

Mr. Doherty hoped the association would take some action tending to support the Louisiana Purchase Exposition, to be held at St. Louis in 1904. The National Electric Light Association has already passed resolutions fixing its place of meeting in 1904 at St. Louis, and he suggested that the Northwestern Electrical Association elect to hold its summer meeting at St. Louis, or else join with the National Electric Light Association at the latter's convention in 1904.

Mr. Bowen moved that action on this communication be reserved until the appointment of a committee on summer meeting.

Mr. Gille—I think the point Mr. Doherty refers to there is very well taken, and that is the fact that by these various associations deciding to hold their meeting at St. Louis, the manufacturers will be largely influenced in making arrangements for their exhibits there; and it is important that action should be taken up early, because these matters will be decided upon by manufacturers before our next meeting, and I think that some action should be taken now.

President—Very well.

Mr. Barron—In order to bring this matter to a head, I move you that we hold our summer meeting at St. Louis in 1904 in conjunction with the National Electric Light Association meeting.

After some debate the motion was carried.

The first paper on the programme by Professor G. D. Shepardson was postponed until the Thursday morning session, and a paper was read by Mr. Thomas R. Mercein, subject, "Association History."

A vote of thanks was tendered the secretary for his very able paper, and a committee appointed, of which the secretary should be a member, to act upon the suggestions contained in the paper.

The next paper, entitled "Metal Preservation," was read by Professor A. H. Sabin, of New York. This paper was thoroughly enjoyed and ably discussed.

A recess was here taken until 10 A. M., January 22, 1903.

THURSDAY'S SESSION.

The meeting was called to order by the president, Mr. Irving P. Lord, at 10.45 A. M. As there were no written questions and answers, the members indulged in a very interesting and valuable discussion of matters pertinent to central station practice.

The committee appointed to report on the communication received from the American Institute of Electrical Engineers then presented through Mr. W. T. Putnam the following report:

MILWAUKEE, Jan. 21, 1903.

To the Northwestern Electrical Association.

Gentlemen:

We, your committee, to whom the report of the joint committee of the American Institute of Electrical Engineers and of the Underwriters' National Electrical Association was referred, would report

that we recommend that the association endorse the adoption of this report by the joint committee.

Signed,
W. T. PUTNAM,
R. N. KIMBALL,
P. H. KORST.

The report of the joint committee referred to is as follows:

REPORT OF JOINT COMMITTEE.

It was agreed that the following additional clauses should be inserted in the National Electrical Code, under Rule 38, after clause (*a*):

(*b*) Every precaution should be taken in arranging the routes for extra high-pressure, constant-potential circuits, to avoid exposure to contacts with other electric circuits, and, on existing lines, the routes should be changed, if possible, wherever it may be mutually agreed upon by the parties in interest that there is a liability to contact between the lines.

(*c*) It is desirable that extra high-pressure, constant-potential overhead lines should not be on the same poles with other wires, except signaling wires used by the company operating the extra high-pressure system, and not entering property other than that owned or occupied by said company; also that pole lines carrying extra high-pressure, constant-potential wires should not approach other pole lines nearer than a distance equal to the height of the taller poles.

(*d*) Where extra high-pressure, constant-potential lines must necessarily be carried nearer to other pole lines than is specified in the preceding clause (*c*), or must necessarily be carried on the same poles with other wires, the extra high-pressure wires must be carried above the other wires, and extra precautions must be taken in the line construction in order to reduce the liability of a breakdown to a minimum; as by the use of heavy wires, widely spaced cross-arms, short spans, extra heavy poles properly constructed and supported, extra heavy cross-arms, pins and insulators.

(*e*) Where extra high-pressure, constant-potential overhead wires cross pole lines carrying other wires, the poles of both lines should be of extra heavy and substantial construction. The high-pressure wires should preferably be above the other wires. The height and length of the cross-over span should be such that the radial distance from the lower cross-arms of the upper line to the nearest wires of the line crossed over should be greater than the cross-over span. Whenever it is feasible, end insulator guards should be placed on the cross-arms of the upper line.

Whenever these conditions of height and span at the cross-over are not feasible, a grounded screen of wires should be interposed between the lines at the cross-over with a current-carrying capacity greater than that of any of the upper wires, and of sufficient mechanical strength to prevent the upper wires from coming into contact with the lower.

It was moved that the report of the committee be adopted and that the association endorse the rules as reported by the committee. This motion was subsequently carried.

The following applications for membership were presented, and the applicants unanimously made members of the association:

W. B. Jackson, consulting engineer, 616 Lake street, Madison, Wis.

Wm. J. Trott, manager Electric St. Company, Big Rapids, Mich.

J. H. Nibbeling, electrical engineer, 1925 Walnut street, Milwaukee, Wis.

Mr. J. W. Shuster then read a paper on the subject of "Rates and Methods of Charging."

This paper was the subject of a prolonged discussion, which was closed on motion, and Professor Shepardson then read his paper on the "Economic Value of Testing."

A vote of thanks was tendered to Professor Shepardson for his paper.

The session then adjourned until 2.15 P. M., when nominating committee presented the following report:

President, F. W. Bowen, Kenosha, Wis.

First vice-president, H. J. Gille, St. Paul, Minn.

Second vice-president, A. M. Barron, South Bend, Ind.

Secretary and treasurer, Thomas R. Mercein, Milwaukee, Wis.

Board of directors—S. B. Livermore, Winona, Minn.; T. F. Grover, Fond du Lac, Wis., and J. H. Harding, La Porte, Ind.

Motion was made, seconded and unanimously carried that the report of the committee be adopted and that the ballot of the association for the candidates be cast by Mr. George Cutter. Mr. Cutter cast the ballot.

The chair appointed Mr. Almert and Mr. Gille and Mr. Cutter to escort the president-elect before the convention. Upon being presented to the convention by President Lord, Mr. Bowen said: "It is needless for me to say that the position to which you have elected me is an honorable one, and is also needless for me to say that it is a position which should be filled by a thoroughly earnest and thoroughly competent man—such men as have filled the position in the past. That you have made an error in your selection, gentlemen, is no fault of mine, and I can only assure you at the present time that whatever is to the interests of this association as an association, whatever will best conserve its interests and will best elevate the association, I shall do if within my power."

It was moved and carried that the present committee on the uniformity of advertising matter be continued and that the chairman of that committee have authority to appoint sub-committees in such states and in such territory as may to him be deemed desirable, and that he get such information as he needs and is for the interests of the association, and that the report of the committee be made at the next meeting of the association.

The next on the programme was a paper on automatic voltage by Mr. H. C. Wirt, of New York. Mr. Wirt's paper was illustrated by curve sheets and blue-prints, and was discussed with interest.

Mr. W. D'A. Ryan then delivered a lecture illustrated with lantern views on the subject of "Modern Illumination." This lecture was supplemented by a great amount of interesting data on the practical use of concentric and adjustable diffusers.

Adjourned to 10 A. M. next day, January 23.

The president-elect, Mr. F. W. Bowen, called the Friday session to order at 10 A. M. The secretary announced that there was no further business, and the convention adjourned *sine die*.

CONVENTION NOTES.

SOME OF THE MANUFACTURERS REPRESENTED.

Headquarters were opened up by a number of firms on the parlor floor of the Hotel Pfister, and several interesting exhibits added to the pleasure of the association members and the visitors.

The Christensen Engineering Company, Milwaukee, was represented by A. W. Watkins, president; F. L. Hutchinson, manager of electric sales; Charles D. Knight and H. Richards.

The General Electric Company was represented by H. C. Wirt, engineers' supply department, Schenectady; P. D. Wagoner, transformer department, Schenectady; Thomas Ferriss, supply department; F. N. Boyer, manager supply department, Chicago; F. G. Vaughan, meter department; W. D'A. Ryan, arc lamp department, Lynn, Mass.; J. Scribner, manager lighting department, Chicago; S. F. Dibble and D. N. Beardsley, Chicago; G. H. Stickney, arc lamp department, Lynn, Mass.

The Garrigus Boiler Company was represented by W. R. Mason.

The Dearborn Drug and Chemical Company was represented by P. H. Early.

The Electric Appliance Company, Chicago, was represented by M. I. Bennett, W. P. Upham and F. McMullin.

The Standard Underground Cable Company was represented by J. R. Wiley and E. J. Pietzcker.

The Fort Wayne Electric Works was represented by Walter S. Goll, I. S. Jackson and J. H. Raymond.

The Julius Andrae & Sons Company

was represented by H. P. Andrae, J. C. Schmidtbauer and F. T. Andrae.

The Crouse-Hinds Electric Company was represented by F. F. Skeel.

The Illinois Electric Company was represented by C. W. Bacon, N. G. Harvey, L. K. Cushing and its usual bowl of punch.

The Westinghouse Electric and Manufacturing Company was represented by W. D. McDonald, A. L. Millard and W. R. Pinckhard.

The Sprague Electric Company was represented by Alex Henderson.

The Stanley Instrument Company, Great Barrington, Mass., was represented by F. J. Alderson.

The New York & Ohio Company, Warren, Ohio, was represented by L. Chadwick.

The Whitoc Electrical Instrument Company, Penacook, N. H., was represented by J. Nevins.

The Monarch Electric and Wire Company, Chicago, was represented by C. A. Kuhlmann.

Pawling & Harnischfeger, Milwaukee, were represented by H. D. Latimer.

The Holophane Glass Company was represented by V. R. Lansingh and Chas. A. Howe.

The Columbia Lamp Company, St. Louis, was represented by Mr. Garrison and H. Cole and John A. Stewart, Cincinnati.

The Kuhlmann Electric Company, Elkhart, Ind., was represented by E. Kuhlmann.

The Bryan-Marsh Company was represented by George L. Kelch, Joseph L. Barnard and L. P. Sawyer.

The Adams-Bagnall arc lamps were represented by the Electric Appliance Company.

The Packard incandescent lamps and transformers were represented by the Electric Appliance Company.

The Osborn Morgan Company, Cleveland, Ohio, was represented by P. J. Morgan and Joseph Melzer.

Pass & Seymour, Incorporated, were represented by John W. Brooks.

The Jandus Electric Company, Cleveland, was represented by its Milwaukee agents, Keelyn & Smith.

The H. T. Paiste Company was represented by its Chicago western representative, E. D. Jenkins.

The Varley Duplex Magnet Company was represented by Charles L. Hibbard.

The Gould Storage Battery Company, New York, was represented by E. L. Draffen.

The Electric Storage Battery Company, Philadelphia, Pa., was represented by G. H. Atkin and Otto E. Osthoff, of Chicago.

The De Laval Steam Turbine Company, Chicago, Ill.

The Curtiss-Crippen Engineering Company, Chicago, Ill.

The Gregory Electric Company, Chicago, Ill., was represented by R. H. Watson.

The Wagner Electric Manufacturing Company, St. Louis, was represented by R. J. Russell.

Dinner to Marconi.

A dinner was tendered to Signor Guglielmo Marconi at the Metropolitan Club, New York city, by the directors of the Marconi Wireless Telegraph Company of America on Saturday evening, January 24. The dinner was given in honor of the achievements which Signor Marconi has made in his application of a commercial system of wireless telegraphy. About fifty persons were present, the assemblage including a number of those prominent in scientific circles and a notable gathering of commercial and literary men.

The menu card was elaborately embellished, adorned with an engraving of Signor Marconi on the cover. The souvenir consisted of a small papier-maché model of the Marconi station at Cape Cod. These were four small grey towers connected by fine wires, set on a base of grass-green pasteboard.

The occasion was presided over by ex-Attorney-General Griggs. Before introducing Signor Marconi, he proposed a triple toast to the kings of Italy and Great Britain and the President of the United States. This toast was drunk standing. Mr. Griggs introduced Signor Marconi with a brief résumé of the great interests which were furthered and the remarkable developments made possible by the work which Signor Marconi has done. In reply, Signor Marconi spoke briefly of the conditions which had more or less hindered the progress of his work, of the realization of a great many hopes, and of the ultimate practicability of establishing commercial wireless telegraphy all over the world. He gave special thanks to the American press and the press of the world, laying particular stress upon the helpfulness which he had found in the attitude which the technical press had always shown toward his endeavors. The pecuniary reward, he thought, should not by any means be the objective of any inventor's designs. There was, in his opinion, a much higher ideal to be reached for—that is, wireless telegraphy reducing the cost of message transmission over long distances and filling a great want of all nations of the earth in bringing them closer together.

Professor M. I. Pupin then spoke in eulogistic strain of the work of Signor Marconi, and predicted that the future would see the promises of the inventor more than fulfilled. Among those present were Sir Percy Sanderson, the Rev. Dr. Burrell, Charles R. Miller, George G. Ward, Professor Francis B. Crocker, W. W. Bradfield, Gustav H. Schwab, Frank J. Sprague, Dr. St. Clair McKelway, S. H. Goddard, ELECTRICAL REVIEW; Hart Lyman, Frederic H. Betts, John J. McCook, T. C. Martin, *Electrical World and Engineer*; Signor das Planches, the Italian Ambassador; W. R. Betts, Herman E. Dick, George R. Sheldon, E. R. Morse, William H. Bentley, Robert Goodbody, J. D. J. Kelley, Eugene H. Lewis, H. H. McClure, Cyrus S. Sedgwick, Spencer Trask, S. S. McClure, Charles J. Steedman, John Bottomley, W. C. Gulliver, Theodore G. Lewis, Charles A. Coffin, John D. Oppe, Ralph Pulitzer, D. O. Mills, A. F. Jacaci, Chester S. Lord, E. W. Rice, F. Benedict Herzog, C. W. Barron, Signor Branchi, Italian Consul-General; Benjamin T. Cable, Eugene Griffin.

American Institute of Electrical Engineers.

TO THE EDITOR OF THE ELECTRICAL REVIEW:

I write to inform you that the American Institute of Electrical Engineers at a meeting of its board of directors, held recently, passed the following resolution:

Resolved, That this Board disapproves of the State of New York establishing a State Laboratory and Standardization Bureau.

Very respectfully yours,

SAMUEL SHELDON,

Chairman Special Committee on State Laboratory and Standardization Bureau.

The action of the board of directors is understood to be based upon the following objections: It was thought that it would be very difficult, if not impossible, to retain a state laboratory upon the high plane necessary if it was to command the influence and authority essential for its success; that it would be dragged into undesirable contentions between municipalities and contractors, and ultimately would be confronted with the whole question of municipal ownership; that it is desirable to keep all advanced research work under the control of the National Bureau of Standards at Washington; and that as this bureau intends establishing sub-bureaus where standards of weight measures would be deposited for reference, this would do away with one of the reasons for establishing the state laboratory.

The State Commission which recommended the establishment of the state bureau was composed of State Engineer Edward A. Bond, Mr. Charles P. Steinmetz, past-president American Institute of Electrical Engineers, and Mr. Harold P. Buck, electrical engineer of the Niagara Falls Power Company.

Railless Electric Trolley System.

By Enrico Bignami.

ONE of the great attractions of the roads in Valentino Park, at Turin, during the Exposition of Modern Arts recently closed was a railless electric trolley system, the receipts from which were very gratifying. This line was constructed by the firm of Siemens & Halske, of Berlin. To-day it has a competitor in the Braunschweigische Maschinenbau-Anstalt Company, which has adopted the Marcher system, named after its inventor.

This system is shown in the following illustrations, Fig. 1 being the car and controlling apparatus. Figs. 2 and 3 show the collector in perspective and section. Fig. 4 shows the arrangement for paying out and lengthening the collecting cable. Fig. 5 is a diagram of the operating circuits.

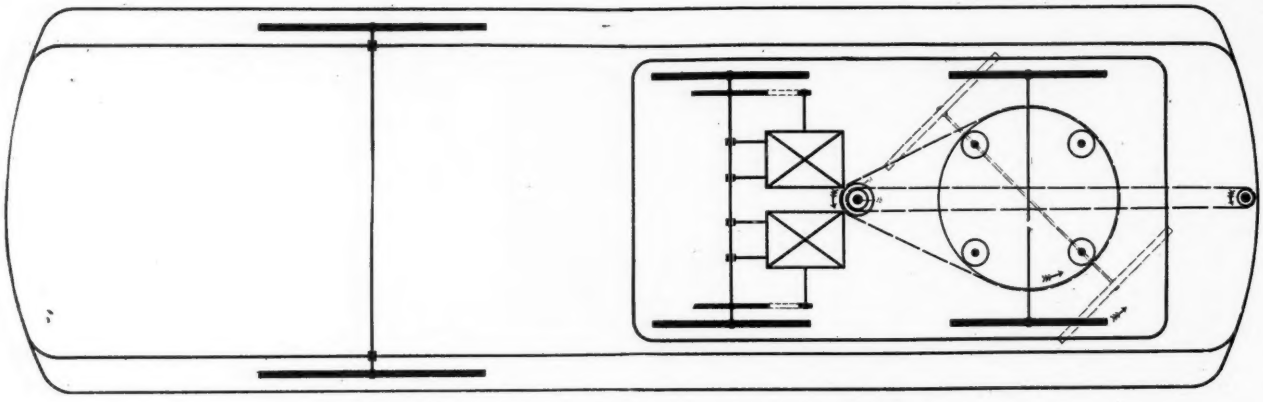


FIG. 1.—THE DIAGRAM OF THE CAR AND CONTROLLING SYSTEM.

It is well known that the chief requirement for these vehicles is means for guiding and controlling if they run on wheels under the same conditions as other vehicles—that is to say, they must be able to turn out, pass, turn around, etc. Recognizing that these vehicles must be constructed as light as possible, to the end that the pressure on the wheel axles may be diminished, a construction is chosen having more than two axles. Fig. 1 shows this arrangement according to the model. To the left is seen the rear axle connected through springs with the body of the car. To the right is a truck, turning about a pivot, which carries two axles, and is placed under the body of the car. The rear one of these two axles supports two motors, and is connected by means of springs with the beams of the truck, while the front axle, which is held in place by the ring, *h*, and the small rollers can be turned about as shown. The driver's position, as is usual in other systems, is on the platform in front. The guide rod terminates below the car at *k*. A moment's reflection will show that this can not act directly on the axle, *w*, for the truck does not turn about *k* as a centre, but about *b*. It is necessary, then, to secure motion about *k* through the wheel, *j*, which turns about the pivot, *b*. From here motion is transmitted to the guiding ring, *h*, and the axle, *w*, as is shown in the figure. Since the front axle carries the least weight, it is subjected to very little pressure. The middle axle and that in the rear follow the direction taken by the front axle, so that one can guide the car rapidly and precisely.

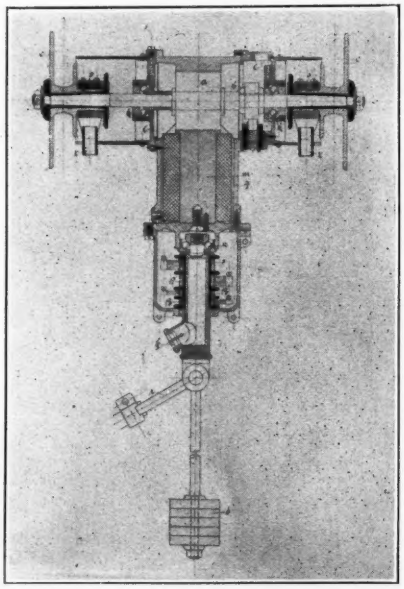


FIG. 2.—THE COLLECTOR IN SECTION.

The characteristic of the railless trolley system is the conductor from which the system receives its name. This conductor must not prevent the car from turning out, passing, turning around, etc. It must maintain taut the collecting cable, and must be able to turn in a large or small circle without putting too great a tension or pressure on the conducting wires, and without injuring the cable in spite of the many complexities. The conductor shown in Figs. 2 and 3 realizes these conditions.

In these figures *a* represents the armature, *m* the field magnet and *g* the case of a small electric motor. The axle, *b*, of this is supported by the traveling and collecting wheels, *c*, which are insulated from the shaft, as are also the collecting brushes, *s*. The covers of the bearings, *l*, are also insulated, as is the cover, *g*, and the axle, *b*, which turns in the ball-bearing, *k*. A brief examination shows that the axle of the small motor rolls on the conducting wires, while the magnet, which is suspended from the same axle, is prevented from turning by its own weight and that of the counterpoise. The collecting cable, *f*, is not directly attached to the collector, but to a lever, *r*, from the pendulum, *d*. To prevent the cable from tangling in making a turn, the conducting wires are connected to collecting brushes, *t*, through the contact rings, in $p\ p^1$, etc., in such a way that the lower part can be moved independently of the upper part on the ball-bearing, *n*.

Fig. 5 shows the diagram of connections and controlling apparatus. In this figure *o* represents the controller for the car motors, *a* and *w* the arrangement for controlling the collecting motor. This latter is attached to *o*, which will therefore operate at the same time and in the same way as the collecting motor through *q*; *u* is a hand regulator which

serves to adjust the number of revolutions made by the collecting motor in the first instance; *z* is a small switch for moving the collecting motor forward or backward. The collecting circuits and the circuits of the collecting motor are seen clearly in the figure to the right. The usual length of the collecting cable is such that the car can turn to either side eight metres from the wire. In case it is necessary to increase this distance, the construction of the collecting pole which holds the cable is such that the distance can be doubled. For this purpose the upper part of the rod, Fig. 4, is flexible and is held in its vertical position by the spring, *e*. Whenever the rod receives a small shock, the flexible part moves the catch, *f*, to the left, so that the ring, *g*, to which the cable is fixed, is released, and the coil, *i*, unrolls and lengthens the cable.

Railless electric trolley systems are the latest novelty in the electrical industry, and are beginning to interest a large part of the industrial world. Similarly to tramways having rails which needed some years for their development, and have, as

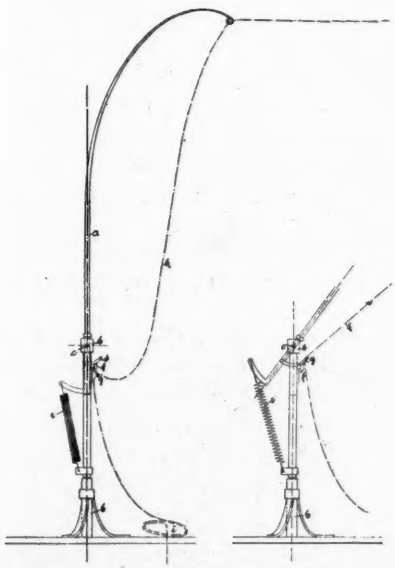


FIG. 4.—THE ARRANGEMENT FOR PAYING OUT OR COLLECTING THE CONDUCTING CABLE.

a result, carried all before them, the railless trolley system will need, as did the former, some time for its development. About a half dozen of these roads are to-day working without intrruption, while a dozen more are being constructed. Since we have not secured as yet a reliable light accumulator of a large capacity, and at the same time compact, the railless trolley system has a brilliant future before it.

Safety Device for Railways.

A consular report from Berlin describes an automatic alarm system which has been

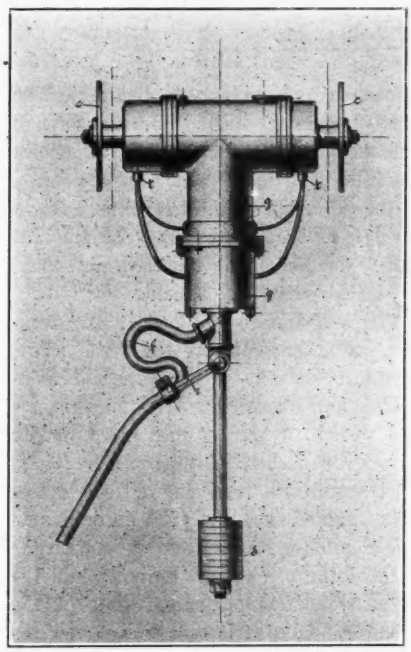


FIG. 3.—THE COLLECTING APPARATUS IN PERSPECTIVE

tested on one of the government railroads near Frankfort. A light third rail, having a T-section, is laid between the main rails, the joints being bonded. Under the forward part of the engine a contact shoe is attached. From this are carried wires to an electric bell and incandescent lamp and a telephone in the cab. A device which automatically shuts off the steam and applies the brakes may be added. Tests conducted last fall gave very satisfactory results. The device is thought to be very valuable, since it puts the engineer in touch with all trains on his section, and with all switchmen and stations. The German Government has directed that a section of the track be equipped, where the system will be put to a thorough practical test.

Lehigh University Register.

The register of Lehigh University, South Bethlehem, Pa., just issued, shows an attendance of 581 students from twenty-seven states and six foreign countries. There are fifty-two in the teaching staff. Twelve courses of instruction are offered at the university, including the usual engineering work. These are well attended, there being 105 students taking the course of electrical engineering.

The Wisconsin *Engineer* for December, contains a contribution by Professor C. F. Burgess on "The Electrolytic Rectifier," being a study of the apparatus and an analysis of its behavior. Mr. L. M. Hancock describes the exciter combination used by the Bay Counties' Power Company, this consisting of an exciter driven by a Pelton wheel and an induction motor, the combination being self-governing. The electrical engineers and mechanical engineers' trip is described which was one of the most successful ever taken, and included visits to Buffalo, Niagara Falls and Pittsburg. These trips are always helpful to the students, and are a valuable feature of the engineering instruction work.

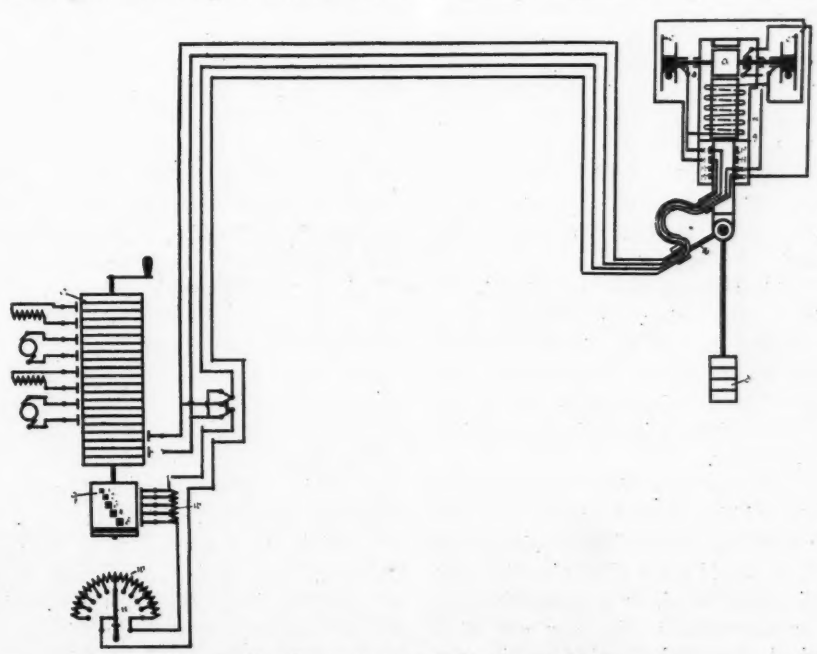


FIG. 5.—THE DIAGRAM OF THE OPERATING CIRCUITS.

American Institute of Electrical Engineers.

"Telephone Exchanges," the Subject of the 172d Meeting, Held in New York City, January 23, 1903.

THE 172d meeting of the American Institute of Electrical Engineers was held at 12 West Thirty-first street, New York, January 23, 1903, and was called to order by President Charles F. Scott.

The secretary announced that at the meeting of the board of directors held during the afternoon 111 associates had been elected, and three associates had been transferred to full membership, namely, L. W. Stanton, of Chicago; Max Esterberg, and W. S. Thompson, of New York city.

Mr. T. C. Martin, chairman of the reception committee, announced that the annual dinner will be held at Sherry's on Monday, February 9, and will be called the "Library Dinner."

Following the gift of Dr. Wheeler, of the Institute, of the Latimer-Clark Library, the library has grown in a remarkable manner. An old telegrapher, Mr. Andrew Carnegie, when he heard of Dr. Wheeler's gift, immediately said that he would duplicate the value of that donation, and has turned into the Institute funds a sum of several thousand dollars which is being devoted to the building up and extension of the library. Mr. Carnegie has postponed his trip South in order that he may be present at the annual dinner and be the guest of honor upon that occasion. The price of the tickets will be $5 per cover, not including wine. It is proposed to have ladies present.

President Scott then introduced the topic for the evening. He called attention to the many lines of work in the electrical industry as is shown by the breadth and scope of the subjects taken up at the various meetings, this evening the subject was telephony.

Imagination is outdone by invention. What would have been thought of a young man fifty years ago had he predicted that the time would come when his office desk or his home could, in a moment's time, be in conversation with any one of a hundred thousand people in his own city or scattered anywhere within a thousand miles in city or country. The thing has become so common that it has ceased to be a wonder. But it underlies modern existence. The communication between home and the store, the home and the office—in fact, almost every species of communication which formerly required hours or days of time expended for personal travel or for letter writing have been revolutionized by the evolution of the telephone. High-speed tools are modernizing the machine shop; the telephone is the high-speed tool of the commercial world.

The telephone is not merely an invention. The elements are the work of the inventor, but the great system of conductors and connections are more properly the work of the engineer. Consider simply the mechanical apparatus by which the transmitters, receivers and conductors are combined into one great interchangeable flexible system. Here it is that the work of the mechanical designer and the engineer has supplemented that of the inventor. Here it is that we see how the minutest details must be specialized and elaborated to bring the work of the inventor to the service of the people.

The telephone switchboard has not sprung into existence fully equipped for its requirements. It has been an evolution. The requirements themselves have been an evolution. In a score of years a system has been evolved almost perfect in its operation of colossal extent and marvelous in detail. It has brought about in these few years changes in our social and commercial methods greater than have occurred throughout centuries in the past.

The president then introduced Mr. Thomas D. Lockwood, electrical engineer and advisory electrician of the American Telephone and Telegraph Company, who read a paper, entitled "The Evolution of the Telephone Switchboard."

This paper will be printed in full in the ELECTRICAL REVIEW, the first part appearing on another page of this issue.

The discussion was opened by Mr. J. J. Carty, chief engineer of the New York Telephone Company, who said:

"I think Mr. Lockwood is to be congratulated on having condensed into twenty-seven short pages such a succinct and yet complete outline of the history of the telephone switchboard. I think it is safe to say that within no similar period in the history of peace has there been displayed so much energy and so much successful work in connection with any industry. In connection with the efforts which have been made during the past five years, and with the successes which have been attained in the work which has been done in connection with the telephone, the American Institute of Electrical Engineers has particular concern and has particular reason to feel proud, because, beginning with the telephone itself, the foundation of it all, we find the invention to be that of one of our own members, Professor Bell. I regret he is not present with us to-night. In speaking of Professor Bell, we can not help but think also of another distinguished member, Mr. Edison, whose work in connection with the telephone is well known to all. From the foundation work of Professor Bell down almost to the humblest improvement which has not yet been passed upon by Mr. Lockwood, the entire development which has been spoken of to-night has been the work almost exclusively of the members of this Institute. All of the electrical mechanisms or the engineering features in connection with the telephone are the direct product of our own members, or have been produced by those working in cooperation with them or under their direction. I think, therefore, that in no other branch of electrical engineering can it be said that the American Institute of Electrical Engineers is so immediately concerned, and in reference to no other branch of electrical work can it be said that they have a reason to feel such a just pride.

"It is not only as members of the American Institute of Electrical Engineers that we have reason to feel proud of this work, but as Americans we must feel proud. It is nowadays the fashion to talk much, especially in the daily papers, about American industrial supremacy. With braggadocio of that sort I have very little sympathy, but, nevertheless, I feel, and for a peculiar reason I will call attention to the fact, that little, if any, contribution to this art has been made by any other country except America. Of course, I must accept the foundation work which was done by the noble band of immortals which the Old World has given to us, headed by Faraday, and I must accept two other names, who have worked specifically in the telephone field. I refer to Van Ryssleburg, of Belgium, who has given us simultaneously telegraphy and telephony; to the Rev. Mr. Hunning, of the Church of England, who gave us the

granular carbon transmitter, but the form in which it was given was not fitted to survive this evolution of which we have heard to-night, and it took an American to convert the granular carbon of Hunning into the solid-back transmitter of to-day, given to us by Mr. Anthony White.

"Mr. Lockwood tells us of the successes which have been attained in telephone switchboards, but he has said little, if anything, of the failures. For every one of these successes there has been a multitude of failures. Many of the ideas which have been discussed in the paper have been contributed directly by Mr. Lockwood himself.

"After looking over our statistics for the 100,000 instruments in Manhattan, and looking at the trouble records, I find that, using the system described, the telephone station in New York is out of order for a period of one hour and twenty-seven minutes, on an average, during a given year. That means that, on the average, every station will be in good order during the entire year, except for a period of one hour and twenty-seven minutes. These figures are taken directly from accurate records and speak volumes in favor of the new type of switchboard which Mr. Lockwood has described."

Mr. F. A. Pickernell, engineer of the American Telephone and Telegraph Company, referred to one factor that has been taken care of in the new modern switchboard. In the early days of the telephone many exhibitions were given of telephonic transmission between cities over lines of considerable length, but development was not particularly rapid. However, as the switchboard was improved and the number of stations increased, the demand for long-distance service between the cities increased enormously, and every part of the apparatus used in a switchboard had to be designed so that it would work in connection with the long-distance lines. The effort has been made and successfully carried out to arrange the apparatus so that any particular station may be connected with any other particular station within the range of a thousand miles, and the switchboard engineers have designed their apparatus so well that from the telephone station located in our building connection can probably be had with three-quarters of a million, if not a million, other stations, in various parts of the country. None of these results could have been produced or attained if the switchboard work had not been of the highest possible type.

Mr. B. Gherardi, Jr., chief engineer of the New York & New Jersey Telephone Company, called attention to the many kinds of work which the telephone engineer must be prepared to handle. The prevailing idea of the electrical engineer just graduating from college is that in telephony there is little for the engineer to do; that at best it furnishes only a field for the electrician or the mechanician. But it is a grave mistake to assume that with other branches of electrical engineering he has nothing whatever to do. Mr. Gherardi then went on to compare the function of both electric light station and telephone central exchanges, detailing the systems of distribution in a highly interesting manner. He then described the power apparatus and the various fields into which the telephone engineer must enter that he may properly secure the most economical and practical service.

Mr. E. F. Sherwood, superintendent of traffic of the New York Telephone Company, then addressed the meeting, in part, as follows:

"All of the care and thought and effort which have been applied by the ablest engineers to the design and construction of the modern switchboard would go for naught unless, after the switchboard is installed, it is operated in accordance with rigid methods. These methods themselves have gone through the same harsh process of evolution which has given to us the splendid mechanism of to-day. Indeed, the relation between the method of operation and the design of switchboards is so close that there has often been controversy as to which was the more important. Each must be adjusted to the other, and their correct mutual relations must be established. It is a fact, not without significance, that between the highest type of switchboard design and the best operating methods there is no incompatibility. Both may be found together in the same organization, each in its highest form. In fact, I am convinced that in the highest form one can not exist without the other. For the past eight years it has been the practice in New York to make service tests in such a way as to show the quantity of the service received by telephone subscribers. These tests show the time taken by the operator to answer subscribers' calls, the time taken to complete the local and trunk connections, the time taken to disconnect after conversations are finished, the percentage of connections on which irregularities occur, etc. Records of these tests have been valuable not only as a means of showing in what respects improvements in the service might be made, but have afforded accurate information as to the improvements brought about by the installation of relay switchboards.

"The first standard relay switchboard installed in New York was cut into service on November 13, 1898, and the last one, which for Manhattan Island rounded out the conversion of the entire system of local switchboards to a relay basis, was cut into service November 2, 1901. The tests of service for the year preceding the installation of the first relay switchboard in New York and for the year 1902 show the following results:

	Average Time Taken by Operator to Answer.	Average Time Taken to Complete Local Connections.	Average Time Taken to Complete Trunk Connections.	Average Time Taken to Disconnect.
1897.....	7.7	27.6	50.7	17.1
1902.....	3.8	23.7	30.7	2.8

"Further evidence that the installation of relay switchboards has improved the service is furnished by the record of written complaints from subscribers. During the year 1897, when the average number of subscribers' lines in service in Manhattan was 17,066, a daily average of 3.2 written complaints was received, or one complaint a day for every 5,330 lines. During the year 1902, when the average number of subscribers' lines in service in Manhattan was 49,955, a daily average of 3.3 written complaints were received, or only one complaint a day for every 15,138 lines; or to put it another way, at the rate of one complaint for each line every forty-one years.

"The relay switchboards in New York have been put to the most severe test, and have stood that test in a most satisfactory manner. Since the installation of the first relay board in New York, the number of lines in Manhattan has increased from 20,740 to 53,792, and the number of stations in Manhattan has increased from 25,516 to 91,945. During this time the daily average number of calls originated by subscribers has increased from 243,590 to 549,940, and the daily average number of connections handled by each subscriber operator has been increased from 750 to 1,070; and yet with this very large increase in lines, stations and traffic, and the material increase in the number of calls handled by each operator, the relay switchboards have enabled us to make a very substantial improvement in the service."

In describing the result of the school for operators, established by the New York Telephone Company, on February 1, 1902, Mr. Sherwood said:

"The principal advantages of our present method of instructing new operators

over the old method of training them in the various central offices are as follows:

"(1) The raw student element has been entirely eliminated from the central office, thereby greatly reducing the amount of interference with the service caused by inexperienced operators.

"(2) The students, in being trained by expert teachers, acquire a uniformity of method, which has proved to be very beneficial.

"(3) The time required to develop a new operator into an expert operator has been reduced two months by the establishment of the school.

"(4) The total cost of training operators in the school is less than it was when they were educated in the various central offices.

"The necessity for our present method of training operators becomes apparent when it is understood that in order to fill vacancies caused by resignations and to fill positions caused by the increase in the New York Telephone Company's business, and to supply operators for subscribers who take private branch exchange switchboards, of which there are 3,300 in Manhattan, we are obliged to train upward of 700 operators a year. It is interesting to note in this connection that there are more than twice as many operators employed in operating private branch exchange switchboards as are engaged in the various central offices in Manhattan.

"To adequately deal with the traffic question and operating methods required in connection with growing systems and changing types of switchboard, there has come a demand for the telephone engineer specially skilled in these matters. In all of the large telephone companies nowadays we have a traffic engineer, whose special duty it is to study switchboard problems in their particular relation to operating methods."

Mr. Kempster B. Miller, engineer of the Kellogg Switchboard Company, stated through Mr. Carty that he was unexpectedly called to California, and sent his regrets that he could not be present and take part in the discussion.

The next speaker was Mr. G. C. Allen, superintendent of construction of the New York Telephone Company. After giving some thought to the subject, Mr. Allen has concluded that while the central office apparatus is of controlling importance in telephone systems, it would, after all, be of little use unless it were supplemented by adequate provision for the outside plant. The central office apparatus may be considered as the cerebral headquarters of the telephone system, it is the brains of the working plant. But as the brain, without nerves extending to all parts of the body, would be unable to perform its function, so would a telephone central office be without purpose unless there were leading from it to all parts of the district served suitable conductors cooperating with the organization represented at the central office.

"With the advances of central office construction and with the enormous increase in conductors in such cities as New York has come a greater extension of underground wires. At the present time I think it may be stated, without fear of contradiction, that considering the total mileage of wire employed, that a larger percentage in mileage of the conductors on Manhattan Island is underground than may be found in cities elsewhere. At the present time on Manhattan Island there are installed as part of the telephone system, outside of the company's, 222,543 miles of telephone conductors. Of this vast mileage of wire, 98.08 per cent is wholly underground. Substantially all of these wires are paper insulated and covered with lead pipes. Within these lead pipes the paper insulated wires must be hermetically sealed. Exposure to the air, due to a perforation of the lead pipe, even so small as a pin-head, would result in the ultimate failure of the cable. This perforation of the lead pipe is as certain to produce trouble in the underground cable as would a perforation in a can containing vegetables be attended by the decay of its contents.

"To give an idea of the magnitude of the task of maintaining all of these wires in lead pipes which shall be practically hermetically sealed, I may state that the total area of the lead covering required to enclose these 222,440 miles of conductors amounts to more than fifty acres.

"The last central office converted from the magneto to the standard type of switchboard was the Cortlandt street office, which was done a year ago. The work of establishing the new central office involved an additional story on the building, putting in new switchboard, and a rearrangement of all cables. Some of the cables had to be handled two and three times, and there were over 20,000 to be handled and reterminated in the new terminal room and connected to the switchboard. When the switchboard went into service on Monday morning—we generally do work of this character on Sunday—it was found that five or six of the circuits were misplaced and that connections on ten or twelve had not been properly made. These troubles were remedied, and the rest of the subscribers did not realize a change had been made in the system."

Mr. William J. Hammer then read briefly extracts from his paper, entitled "An Automatic Telephone Operator," but owing to the extreme lateness of the hour the discussion of this subject was very brief.

Mr. Lockwood made a short reply to the discussion raised by the other speakers and made a facetious reference to the automatic operator as follows:

"I think all of you will agree with me that there is certainly one advantage in the mechanical operator—there will not be 700 resignations in a year of operators who desire to get married. I think that advantage, in one sense, is a great deal. The mechanical operator has that advantage over a human operator, as I can not imagine any subscriber, in any possible contingency, wanting to marry one of his mechanical operators."

Mr. F. E. Kinsman stated that he was employed in Boston in August, 1877, and his recollection was that the first exchange was operated by transmitting the message through the operator.

Mr. Lockwood then said that the first exchange was established in Boston in May, 1877, through some burglar-alarm wire, whereupon Mr. Kinsman replied that the exchange was first introduced in Mr. Holmes's burglar-alarm office, and it was made by the operator taking the message and turning about and talking through the telephone to the party to whom the message was to be given.

The meeting then adjourned.

BOOK REVIEW.

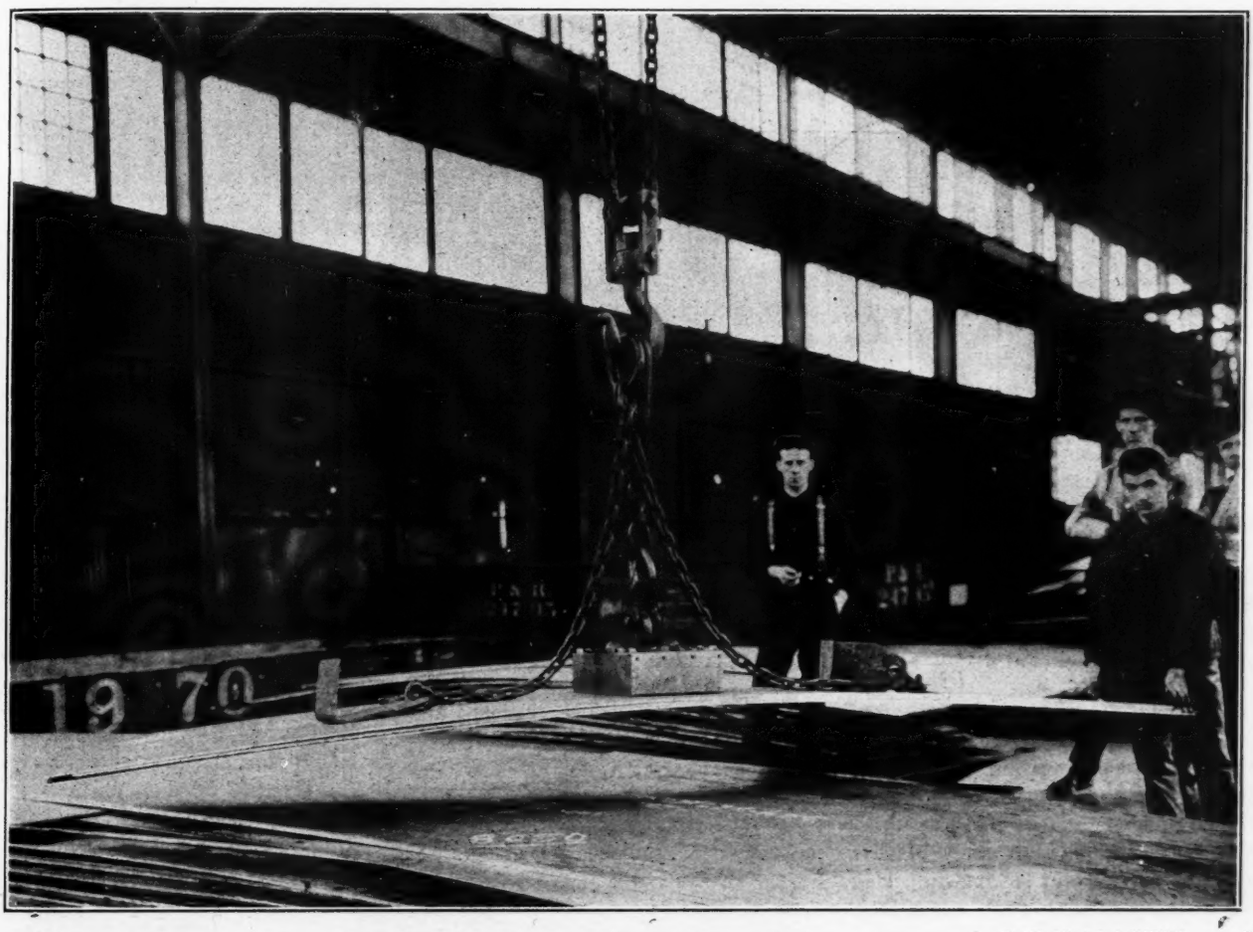
"Electrical Problems for Engineering Students." William L. Hooper, Ph. D., and Roy T. Wells, M. S. Boston and London. Ginn & Company. Cloth. 170 pages. 8¼ by 5¾ inches. Numerous diagrams. Supplied by the ELECTRICAL REVIEW at $1.35.

The authors of this book believe in the value of numerical examples for fixing principles in the students' minds. They have here brought together a large number of problems, most of which have already been presented to students. The first chapter is devoted to a comparison of the C. G. S. and English systems of weights and measures. The second chapter takes up current, electromotive force and resistance, and gives the student a thorough drilling in the use of Ohm's law. Following this, resistivity is studied, and then grouping of electromotive forces and resistances. The chapter on power and efficiency is particularly good. Thermoelectricity and electrochemistry are treated briefly, and alternating-current problems fully. The latter part of the book is devoted to the more practical questions of testing and design. A complete wire table is given in an appendix. Answers to all problems are given in the back of the book.

Electric Lifting Magnets.

By Waldon Fawcett.

ELECTRIC lifting magnets are rapidly attaining recognition as among the most important time-saving and labor-saving appliances which have been introduced in the industrial world in some time past. The electrically energized lifting magnets are now in use in connection with cranes and other types of conveyors at the plants of the Otis Steel Company, at Cleveland, and the Illinois Steel Company, at Chicago, the yard of the New York Shipbuilding Company, at Camden, N. J., and other notable institutions famous for the perfection of their equipment, and in every instance they have given the most gratifying satisfaction. This general introduction in smaller metal-working establishments has been somewhat retarded by reason of the fact that many plants of moderate size have not been fully equipped with electric power, but this obstacle is, of course, but a temporary one.



LIFTING SHEARED PLATES BY ELECTROMAGNETIC LIFTING HOISTS.

The principle of the electric magnet has been known since the earliest days of electrical science, and was at various times taken advantage of, although never in the degree which has attended its later development. The essential qualification that the material to be handled shall be magnetic would appear to limit the operations of the electric lifting magnets to iron and steel—an immense field in itself—but it has been conclusively proven that almost any other material may be handled by the use of iron receptacles, just as conveyor buckets might be used in connection with cranes or derricks.

One of the great spheres of usefulness of the electric lifting magnet is found in its application to moving and handling bulky material of size and shape, such as to render difficult its transportation by any other method. By the use of two, three or four lifting magnets operated in conjunction really surprising results may be attained. Thus in rolling mills such a combination of magnets will handle easily a steel plate forty-two feet in length, eight feet in width and one-half inch thick, and moreover will move it at a time when the plate is so hot that it could be handled only with the greatest danger and difficulty were it necessary for workmen to adjust chains with which to lift it. Each electric lifting magnet displaces a gang of from six to twelve laborers, inasmuch as one operative can manipulate a magnet, or indeed two or three magnets if they be employed in the same operation. The mode of operation is simplicity itself. The magnets are lowered until contact is made with the plate or other piece of material to be handled, and after the current has been turned on the load is hoisted and moved by means of the crane or conveyors to any part of the shop or storage yard.

It has been urged against the electric lifting magnets by persons who are sceptical regarding the claims of superiority put forth in their behalf that the danger of a failing current imposes an ever-present liability to the release of the plate by the magnet, causing delay and possibly

resulting in serious injuries to workmen who might be passing underneath, but it must be said in all fairness that such accidents have been almost unknown at the plants where the electric lifting magnets have been in use for some months past, and at any rate the delays are certainly not more serious than was occasioned by the slipping of chains under the old method.

Electromagnets, as now in use, differ considerably in design, but the most popular form is a simple horseshoe with one limb so developed as to form an envelope for the rest of the magnet. This type has, however, proven inadequate for certain grades of work, notably plate handling, on account of the shape of the pole-face and the excessive leakage from pole to pole. In the experiments made to devise the most efficient form of magnet many surprising disclosures were made. For instance, it was demonstrated that a round magnet which would on a straight pull easily lift five tons, was incapable of picking up a long thin plate weighing only half a ton. After thorough investigation most engineers have adopted a group of rectangular poles as the best for plate-handling, which, as previously intimated, constitutes the most important use to which the lifting magnets have yet been put.

Electric Lifting Magnets.

One of the most interesting qualities of the electromagnet is found in its capability, under regulation of the strength of the magnet, to pick up several objects or only one. This may be accomplished by means of a rheostat in series with the winding, but the preferable method is for the operator to drop off superfluous material by opening the switch and suddenly closing it. The current consumption of a lifting magnet is dependent, of course, upon the winding of the coils, but as a rule a magnet operated on 1,000 watts will have a capacity for handling fully 3,000 pounds of sheared plates under any and all conditions and may, under exceptional circumstances, handle loads up to five tons.

In many of the horseshoe type of electromagnets, horns are provided at the sides for attaching sling chains in case of the disablement of the magnet. As indicating the capabilities of even the less perfect magnets, it may be cited that at a recent test a magnet of the modified horseshoe design and whose large size naturally entailed a low ratio of lifting power to weight lifted a load in excess of twelve tons with thirteen amperes at 250 volts or 3,250 watts. The weight of this magnet is 1,235 pounds, which renders the ratio of weights in the case of the test in question about nineteen.

Tests of a representative bipolar magnet in use at the plant of the Illinois Steel Company, the magnet weighing 1,200 pounds, demonstrated its capability of lifting six tons with six and one-quarter amperes at 250 volts or 1,562 watts. This magnet is capable of picking up several plates at a time. Tests such as those above outlined are not, however, of much value as criterions of the practical working efficiency of magnets as may be surmised from the fact that the round magnet which at the test showed a ratio of nineteen is not, under actual working conditions, anything like as satisfactory as the long magnet, the ratio of which in this particular test was but ten. As affording further comparison it may be noted that the coil of the round magnet involves 2,904 turns of wire weighing approximately 217 pounds, whereas the two coils of the long magnet embody 2,952 turns and weigh 176 pounds.

At the Illinois Steel Company at the present time the favorite type of magnet is a pole-piece of five inches cross-section, and three and one-half inches length with the coils surrounded to a depth of fully three-quarters of an inch. The magnet face is rectangular in form. The weight of this magnet is but 300 pounds and in a test corresponding to that to which the bipolar magnet previously mentioned was subjected, it lifted four tons, indicating a ratio of twenty-seven. This magnet can be operated with four amperes at 230 volts or 920 watts, but usually takes 4.4 amperes at 250 volts or 1,100 watts.

When it is desired to provide magnets for handling a number of plates simultaneously the poles are arranged differently from those in the standard type. Plates which are only a couple of feet square are usually handled on edge, but the larger size plates must be picked up flat, one on top of another. Various arrangements of small pole units are adapted to special lines of work, as for example the circular structure which has proven most advantageous in handling car wheels. The cost of electric lifting magnets show much the same range that is observable in their capacity, and the ratio of lifting power to weight of magnet.

Boston Local Section of the Institute.

A joint meeting of the local section of the American Institute of Electrical Engineers and of the Massachusetts Institute of Technology Engineering Society will be held at the Tech Union, on Garrison street, Boston, February 13. Professor Elihu Thomson has been invited to preside. Mr. Thomas D. Lockwood will read his Institute paper on "The Evolution of the Telephone Switchboard." An interesting discussion is expected.

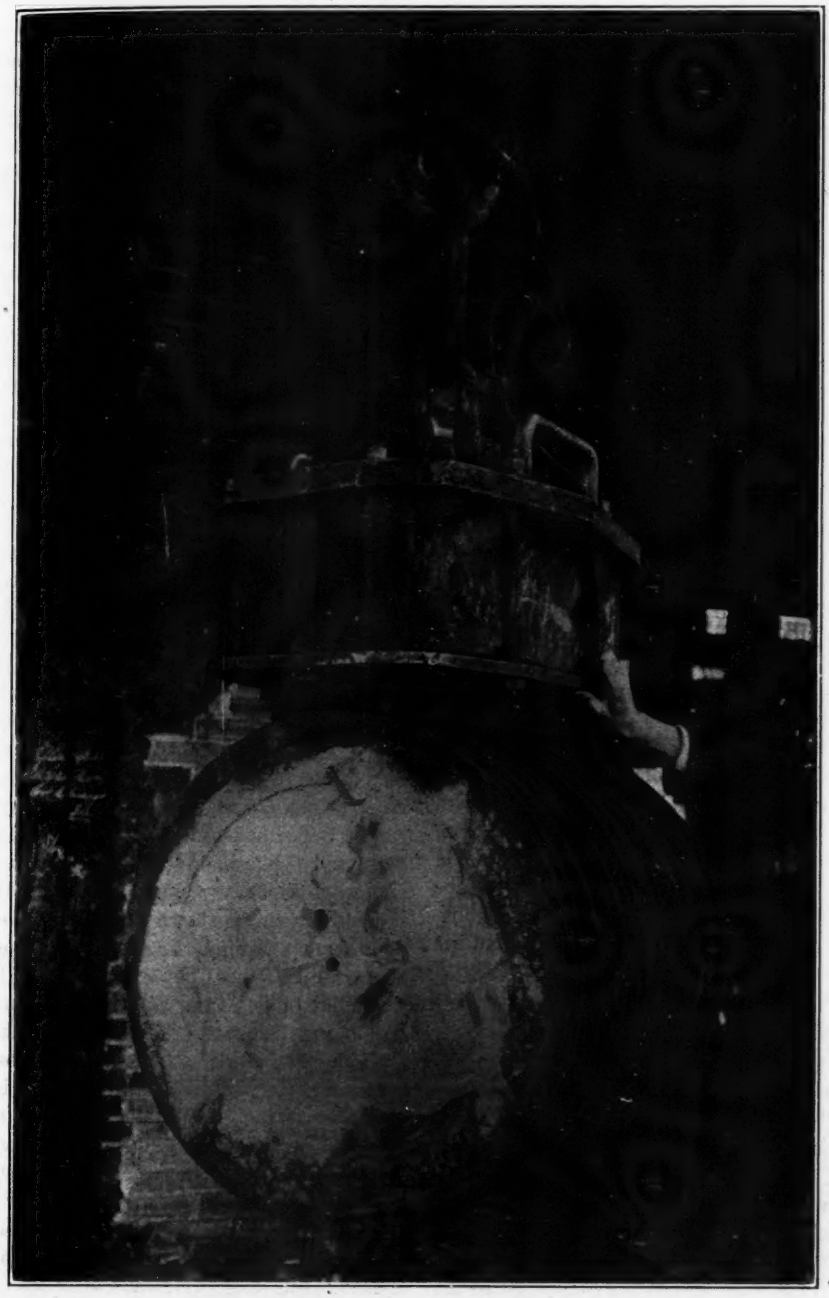
Johns Hopkins University Circular.

The December number of the Johns Hopkins University circular contains several very valuable notes from the mathematical seminary. These include a study of "The Hypocycloids of Class Three, Inscribed in a Three Line," by H. A. Converse; a second contribution by the same author on "The System of Hypocycloids of Class Three;" "The Proof of the Impossibility of the Construction of One of the Kantor Configurations," by W. B. Carver, and "A New Circle Which Arises from Any Number of Directed Lines," by C. E. Brooks.

*ON ELECTRONS.**

BY SIR OLIVER LODGE.

Two substances placed in contact and separated are in general united more or less permanently by lines of force, the region between them being in a state of tension along the lines and of pressure at right angles. These lines have direction; they begin at one body and end at another; they map out a field of electrostatic force, and their terminations on one or other of the bodies constitute what we call an electric charge. Electric charges are of two kinds—one corresponding to the beginning of the lines, the other to their ends. To one class of bodies, called insulators, the lines appear rigidly attached; whereas in another class they slip easily along, and are transferred from one such conducting body to another in contact with it, with great ease.



ELECTRIC LIFTING MAGNET.

The tension in the lines tends to bring the ends together as near as possible, giving rise to what is observed as electrical attractions and repulsions.

Now consider how far this field of force belongs to the body, and how far it belongs to space, that is to the ether surrounding the body. The body is the nucleus whence the lines radiate, but the lines themselves, the state of tension and other properties which they represent and map out, do not belong to the body at all; at each point of space there is an electric potential, and this potential represents something occurring in the ether and in the ether alone.

A CHARGED SPHERE.

Picture in the mind's eye such a charged body, say, a charged sphere, and let it change its position; how are we to regard the effect of the displacement on its field of force? Nothing in physics is more certain than this, that when a body moves the ether in its neighborhood does not move.

The effect of the motion of the body, then, is to relieve the strain of the ether at one place and to generate it at another; the state of strain travels with the body, but through the ether.

The question now arises what sort of occurrences go on in the ether when this decay and regeneration of an electrostatic field are occurring, or when a field of force is moving through it? Can it adapt itself instantly to the new conditions, or does it require time? This matter has been studied, closely and exhaustively, by Mr. Oliver Heaviside.

The answer is that during the motion of the charged body, and even after the cessation of its motion, until the disturbance has had time to die away and everything to settle down into static condition again, the phenomena of magnetism make their appearance—a new set of lines of force quite different from the electrostatic lines (although they, too, exhibit a tension along them and a pressure at right angles) come into temporary being.

The locomotion of an electric charge is an electric current, and the magnetic phenomena surrounding that current are believed to be the only magnetic phenomena in existence. If any other variety is possible, the burden of proof rests on those who make the positive assertion.

While the charge is stationary everything is steady, and we have an electric field only. While the charge is moving at constant speed the current is steady, and we have a steady magnetic field superposed upon a steadily moving electric field, and a certain conveyance of energy in the direction of the motion.

But what about the intermediate stages, the stages of starting and stopping; what

* Abstract of paper presented at a recent meeting of the British Institution of Electrical Engineers.

is the condition of things after the charge has begun to move but before it has attained a constant speed, and again when the brake is applied and the speed is decreasing, or when the direction of motion is changing?

We get the phenomenon of induction—the generation of an induced electromotive force, the value at any point equal to the rate of change of the lines of magnetic force there. There being no conductor, this electromotive force will propel no current, but it will represent an electric force which was not there before, and in a new direction, perpendicular to the direction in which the growing magnetic lines are moving, which is outward from the charge. Consequently the new or induced electromotive force points in the direction of motion, though in the sense opposed to any change in it, and the effect of its superposition upon the magnetic field is to cause a certain small transmission of energy in a radial direction out and away from the accelerated charge. Some energy therefore flashes away with the speed of light, though in ordinary cases an exceedingly small amount.

It is from an electric charge during its epochs of acceleration or retardation that we get the phenomenon called radiation; it is this and this alone which excites otheral waves and gives us the different varieties of light.

Thus, or rather by means of a very extensive development of these fundamental ideas, are all the phenomena of electricity and optics summarized, and, so to speak, accounted for.

And the electrical acceleration is opposed by the electromotive force, just as the acceleration of matter is opposed by its mechanical inertia. The coefficient of the electric acceleration represents, therefore, an inertia term, and is properly called electric inertia.

By Lenz's law the effect of induction is always to oppose the cause which produced it. In the present case the cause is the acceleration or retardation of the moving charge, and so on in each case this is opposed by the reaction of the magnetic lines generated by it. Whatever the inertia the body may have, considered as a piece of matter, it has a trifle more by reason of its being charged.

The magnetic lines generated by a falling current, that is by a negatively accelerated or retarded charged body, react oppositely and tend to continue the motion, thus here, also, we have a term corresponding to inertia.

Now any appreciable quantity of matter, even a milligramme, moving with the speed of light, has a prodigious amount of energy, namely, for the mass of one milligramme, 15,000,000 foot-tons.

Consequently the inertia of any ordinary quantity of electric charge must be exceedingly minute. Notwithstanding this, it is quite doubtful whether or not there really exists any other kind of inertia.

The only way of conferring upon a given electric charge any appreciable mass is to make its potential exceedingly high, that is to concentrate it on a very small sphere.

Raise the potential to a million volts, and the mass equivalent to a coulomb at that potential would be the hundredth part of a milligramme, still barely appreciable therefore.

The charge on an atom as observed in electrolysis is known to be 10^{-10} electrostatic units. If this were distributed uniformly on a sphere the nominal size of an atom, *viz.*, one 10^{-8} centimetre in radius, its potential would be one hundredth of an electrostatic unit, or about three volts. The energy of such a charge would be 10^{-12} erg, and the inertia of a body which would possess this energy if moving at the speed of light would be 10^{-33} gramme.

But this is incomparably smaller than the mass of a hydrogen atom, which is approximately 10^{-25} gramme. Consequently the ionic charge distributed uniformly over an atom would add no appreciable fraction to its apparent mass.

If, however, the atomic charge were concentrated into a sphere of dimension 10^{-13} centimetre, its potential would be 1,000 electrostatic units or 300,000 volts, its energy would be 10^{-7} erg, and its inertia 10^{-28} gramme, or about $\frac{1}{1000}$ of the mass of a hydrogen atom.

DISCOVERY OF THE ATOM OF ELECTRICITY.

Quoting from Clerk Maxwell's "Electricity" we find the following sentence:

"Suppose, however, that we leap over this difficulty by simply asserting the fact of the constant value of the molecular charge, and that we call this constant molecular charge, for convenience in description, one molecule of electricity."

Thus some idea of the conception of the atomic nature of electricity was forced upon men of genius by the facts of electrolysis and a knowledge of Faraday's laws.

What we learn from electrolytic conduction briefly summarized is that every atom carries a certain definite charge or electric unit, monads carrying one, diads two, triads three, but never a fraction; that in liquids these charges are definitely associated with the atoms, and can only be torn away from them at the electrodes; that the current consists of a procession of such charges traveling with the atoms, the atoms carrying the charges, or the charges dragging the atoms, according to from which point of view we please to regard the process.

CONDUCTION IN GASES.

The author then described the various and interesting phenomena appearing when an electric current is passed through a tube during the process of exhaustion, the whole tube finally beginning to glow.

CATHODE RAYS.

So far we have supposed that the cathode is a brass knob or other convenient terminal introduced into the tube; but if we now proceed to use other shapes, as Crookes did, using a flat disc or a curved, saucer-shaped piece of metal, and if we then introduce into the dark space various substances, we shall find that the dark space is full of properties which are most clearly expressed by saying that it is a region of cathode rays—that is to say, of rays or something as it were shot off from the cathode. There is evidently something being thus shot off, which, however, is invisible until it strikes an obstacle, something which seems to fly in straight lines and to produce a perceptible effect only when it is stopped. A substance with phosphorescent power, such as many minerals, or even glass, phosphoresces brightly, and the path of the rays can be traced by smearing a sheet of mica with some phosphorescent powder and placing it edgeways along their path. In this way it can be shown that they travel definitely in straight lines, not colliding against each other, but each shot, as it were, like bullets from an immense number of parallel guns. Where they strike the sides of the glass they make it phosphoresce; where they strike residual air in the tube, as they do if the exhaustion is not high enough, they make it phosphoresce also, and give, in fact, the ordinary glow surrounding the dark space.

These rays possess a considerable amount of energy, as can be shown by concentrating them by means of a curved saucer-shaped cathode and bringing them, as it were, to a focus. A piece of platinum put at that focus will (if the exhaustion is not too high) show evident signs of being red hot—that is to say, will emit light. If the exhaustion is higher, less heat is produced, though a phosphorescent light is emitted from suitable substances like alumina and most earths; but if the exhaustion is pressed further still,

the bombarded target emits no visible light but that higher kind of radiation known as Rœntgen or X-rays.

NATURE OF CATHODE RAYS.

We have seen that the impact of the cathode rays, speaking in language appropriate to the assumption that they are charged particles, will result partly in heat, or vibration of the impacted particles; partly in light or phosphorescence, due to the quiver of electrically charged atoms, or rather the electrical charges on atoms, as in the ordinary process of radiation, and partly in X-rays, all of which effects are readily seen at different stages of vacuum in a Crookes tube. The momentum of the flying particles shot off from the cathode can also be exhibited by putting into their path some form of vane or little windmill, which will then be driven mechanically, as the vanes of a radiometer are driven by the recoil of the molecules of the residual air from the warmer surface, a stress being thus set up between the vanes and their glass enclosure. In the electric vacuum tube experiment the stress seems to be between the cathode or gun and the vanes or target, and the propelling force would appear to be the force of electrical repulsion, the particles traveling down the grade of potential just as they travel in ordinary electrolysis; but whereas in ordinary electrolysis they meet with constant encounters and therefore progress very slowly, in the high vacuum they can fly for several inches in a free path without encountering anything, and therefore without causing any disturbance, giving rise to no appearance but that of the dark space. Phenomena occur only where they strike.

This was the view taken by the whole world of the nature of cathode rays after Crookes demonstration; it was supposed that they were flying atoms, and that they were flying with ordinary molecular speed, but with a long, free path—much longer than would have been expected from ordinary gaseous theory. Crookes indeed hazarded the surmise by one of those flashes of intuition which are sometimes vouchsafed to a discoverer, but are often jeered at by orthodox science at the time, that he had obtained matter in "a fourth state," and also that he had got in his tube something equivalent to what was contemplated in the "corpuscular" theory of light.

Meanwhile let us summarize the evidence for the view that the cathode rays are at any rate charged particles of some kind in extremely rapid motion. That they are in motion must be granted from the facts of their bombardment—driving mills, heating platinum and the like. If they are charged while in motion they constitute a current on Maxwell's theory, and therefore should be able either to deflect a magnet or to be deflected by it; and here comes one of the most simple and important experiments in physics at the present time. A definite form of old experiments by Goldstein and many other vacuum tube observers was arranged by Crookes in 1879, when he made the track of the rays visibly luminous by passing a selection of them through a slit and letting them graze along the surface of a film of mica covered with phosphorescent powder, and when he then brought near them a common horseshoe magnet. When this is done the track of the rays is at once seen to be curved, showing that it is not a beam of light we are looking at, but a torrent of charged particles behaving like an electric current and deflected by a magnet.

The mobility or diffusiveness of a gas depends on its mean free path, and that depends on its atomic size; the smaller it is the more readily can it escape collision. Hence it is the collisions are so rare in astronomy; the bodies are small compared with the spaces between them. The behavior of charged particles seemed to indicate that they must in some cases be something smaller than atoms. It seemed hardly likely that material atoms could behave in the way they did, so it was recollected that it had occurred to some philosophers, among them Dr. Johnstone Stoney, that electric charges really existed on an atom in concentrated form, acting as satellites to it; so on that view it was just possible that these flying particles might be not charged atoms at all, but charges without the atoms, the concentrated charges detached, knocked off as it were in the violence of the discharge, and afterward going about free, traveling at an immense pace because they would still be liable to the full electric force that they had experienced before, and yet would have shaken off the encumbrance of the material atom with which they had been associated.

To such hypothetical isolated charges, the unit charge or charge of a monad atom, the name "electron" has been given, and when I speak of an "electron" I mean to signify the at present purely hypothetical isolated electric charge. Whereas by the term "ion" I always signify the atom and its charge together.

Now if the flying particles which constitute the cathode rays were electrons rather than ions, if they were detached charges, leaving the atoms behind them (probably leaving the atoms from which they were detached positively charged), their extreme mobility and diffusiveness and high speed would be perfectly natural; and although they would not be matter in the ordinary sense, yet no difficulty need be felt at their possessing some of the properties of matter, at any rate such properties as appertain to matter by reason of its having inertia, because, as we have seen, an electric charge itself does possess a certain kind of imitation inertia. Hence these electrons in movement would possess momentum, and might therefore propel windmills; they would possess kinetic energy, and therefore might heat a piece of platinum, and if suddenly stopped by a massive target when traveling at a high speed they might readily give rise to phosphorescent appearance, and even to the sudden pulse of radiation known as X-rays. But the existence of this last property ought to be capable of clear deduction on electrical principles if the matter is further gone into.

The Life of Creosoted Telegraph Poles.

At a meeting of the Dublin section of the British Institution of Electrical Engineers, held last December, Mr. A. T. Kinsey gave some interesting figures regarding the life of creosoted telegraph poles. Timber is preferred to iron in pole line construction on account of its lower cost, but, when used, some means of rendering it capable of resisting the attacks of dry and wet rot are necessary. Various methods have been tried, but all have been abandoned except creosoting. One of the best timbers for poles is Norway red fir. All timber must be thoroughly seasoned and dried before treatment.

The quantity of preservative used is eight pounds per cubic foot. It does not penetrate to the heart of the pole, reaching only to a depth of one or two inches when the timber is very dense. This leaves an unprotected portion—the heart and the interior margin of the zone. This unprotected zone is where dry rot usually sets in, but dry rot is comparatively rare. It is found that in course of time the creosote sinks to the base of the pole, forming a thick crust on the surface of the latter where it is most needed as a protection against wet rot, as this latter attacks from without and proceeds inward. In 1880 the life of treated poles was found to be thirty years. Poles taken down in that year which had been planted in 1849 and 1850, were found to be as sound as when erected. Since then creosote has deteriorated in quality owing to the increased value of some of its constituents, so that it seemed desirable to investigate the matter again. The author has traced the erection of creosoted poles in Ireland as early as 1858, and again in 1861, but as a systematic branding of the date of creosoting was not begun until 1873, it is impossible to identify with certainty the poles creosoted before that time. The result of an examination by percussion showed that the poles thus branded are apparently quite as sound as when first erected. Poles dated 1877 were being taken down, but were apparently as good as new, and would pay for reerection.

THE EVOLUTION OF THE TELEPHONE SWITCHBOARD—I.*

BY THOMAS D. LOCKWOOD.

Two poets, as far apart chronologically as Lucretius and W. S. Gilbert, have sung the praises of the magnet; and the muse of Cowper has not disdained to celebrate such homespun and ordinary household gods as the sofa and the timepiece, and though the telephone switchboard is not a prominently manifested effect of a great force of nature, and not even a household god, it is in such close alliance with more than one of nature's forces, and stands in such faithful attendance to some of our home divinities, that it well merits more attention from the chronicler than it has thus far received.

The highly organized and highly specialized collocation of apparatus that we now term the telephone switchboard, and which is at present employed in the large central stations of our great city exchanges, such as the Cortlandt street central station in New York, and the main central station in Boston, as a means of carrying out the varied and complex functions required at the central station end of a great number of telephone circuits, has doubtless been seen by, and is familiar to many of you; while probably many more have a speaking acquaintance with it, and have considered it with more or less attention.

Its present condition of relative perfection and high efficiency has, however, been attained only after persistent effort, and after many previous attempts, each in its result showing some progress, but each indicating or developing faults and errors to be overcome by its successor.

At the outset of the telephone exchange business every telephone man had to learn his trade. Even the telephone itself was but two years old, and except Professor Bell and his immediate associates no one knew anything worth mentioning about that instrument or its capabilities. None certainly could foresee what direction the lines of improvement would take; and none could foreshadow the extent of growth which might be expected for such systems.

But notwithstanding the general ignorance, the telephone exchange came into existence; and with it necessarily came something for the convenient connection and disconnection of lines. It would be profitless to devote much time to the earliest switchboards of all. It is enough to say that during what I may call the dark ages of exchange telephony, the switching appliances were of three different types; and this largely because in the beginning there were three different classes of incipient telephone engineers. The electrical expert coming into the telephone exchange forms the ordinary or regular telegraphic systems, naturally pinned his faith to the standard pin switchboard usually employed by the telegraph companies. Those coming from special systems such as the stock quotation printing, burglar alarm and district messenger companies as a rule exhibited a preference for a switchboard whereon the lines had brass terminal plates with plug holes in them, the same to be united by switch-cords armed at both ends with plugs to be inserted in these holes. The telephone men with no previous telegraphic experience of any kind, chiefly those who had grown up round Professor Bell, and under the influence of his immediate associates, were inclined to eclecticism as regards the rival claims to merit of pin and cord switchboards; but believed in dividing the work of interconnecting and its suboperations between two or more operators, of whom one set received calls and made the required connections on the switchboard proper; while the others acting in some sort as dry nurses to the subscribers, supervised the communication, sent outgoing calls and encouraged the subscribers to talk.

As a means of receiving calls, some of the pioneer switchboards had a row of electric bells mounted along the top of the board, one for each line, and in such cases there was a normally connected battery, supplying current to a group of lines, the bells being operated by break keys at the substation. Still others had closed circuit annunciators, one for each line, these also being operated by breaking the circuit. Soon, however, the battery was discarded, being superseded by magneto generators at the substations, and then of course open circuit annunciators were substituted at the central stations. It is of interest to note that the battery, discarded twenty years ago as a cumbersome adjunct, is now one of the most cherished features of central station practice, and all through the history of telephone practice, thus it has proved, that appliances and methods discarded as being inferior at certain stages, have been revived under the stimulus of more favorable conditions and advanced knowledge, and have turned out to be useful in the highest degree.

Before 1880, it had become decidedly manifest that some kind of telephone exchange service must be provided during the night. Few exchanges could afford to keep regular operators constantly at work later than ten o'clock. Consequently, a compromise measure was resorted to, and a night operator was stationed in the central office with permission to sleep, and a night alarm consisting of a loud sounding vibrating bell was provided, connected in a local circuit extending in one direction to a bar constituting a stop on which all annunciator drops might fall, and in the other direction to all of the several drops, so that the operation of any annunciator would ring the bell and awaken the operator. This contrivance is still employed in many small exchanges, and enables exchanges to remain operative at night, while as yet the number of subscribers is so small that a night attendant could not be otherwise afforded. Before this date it was discovered that while the Western Union pin switchboard unmodified might be a satisfactory switchboard for telegraph offices, it was decidedly unsatisfactory for a telephone exchange. It was slow; it was not easily manipulated; it did not easily lend itself to cooperation with the other exchange apparatus, and it occupied considerable space. In brief, it had been devised for the needs of a telegraph office where a switchboard is but an incidental device arranged mainly to facilitate the connection of any particular line with any particular instrument or battery, and only on rare occasions to connect one line with another. In telephonic work, however, the function of the exchange is the interconnection of one line with another at all times and nothing else. To paraphrase the well-known couplet of Byron, the switchboard is in the telegraph office a thing apart; it is of the telephone exchange the whole existence.

Summarizing these considerations, it may be truly said that the main difference between the telephone exchange switchboard and that of the telegraph office, or any preceding system, was that whereas the manipulation of the telegraphic switchboard involves the employment of experts, the telephonic switchboard is so designed that it may readily be operated with great celerity by persons who are not only inexpert, but who actually are entirely ignorant of the nature of the operations which they continually perform.

In 1880 the most representative exchanges had switchboards employing long branch or painted connection strips

* A paper read at the 172d meeting of the American Institute of Electrical Engineers, New York, January 23, 1903.

extending from end to end of the board. In New York as elsewhere, switchboards possessing this feature were employed, but there the preferred switchboard was operated by cordless plugs, the cross-strips having a number of plug-holes, while a series of vertical conductors representing the subscribers' lines crossed these horizontal strips at a right angle in the rear of the board, these being spring plates overlapping the holes. Thus, when the plug was inserted in the hole of the cross-strip, it made a good rubbing connection with the spring line strip behind. The cross-strips were arranged in pairs and were connected by looping wires to an adjacent table fitted with an operator's telephone and a call generator where connections were supervised, and any two lines concerned in a connection were attached by separate plugs to the two strips of a pair respectively.

In other cities the long brass strips were employed without any vertical line strips, each line being represented by a single spring-jack only. When such was the case the connection could not be effected by simple plug connectors, but necessitated the employment of cords fitted at one end with flat wedges to enter the spring-jacks, and at the other with plugs to enter the holes in the crossing strips. In this case, also, the crossing strips were looped to tables where the connections were supervised by operators.

In these systems an incoming call announced itself by the fall of an annunciator. One of a number of switchmen (so-called) provided with a magneto telephone connected with a loop-plug adapted to fit the spring-jack of the calling line, would plug in and receive the order. The same switchman then united the calling line and the line wanted to the two cross-strips of some particular pair, and thus connected them not only with one another, but also to the table of some particular operator. The operator notified of the connection thus made, would first send a call current from a generator to the subscriber wanted, and receive his answer orally, and would then unite the two lines through a disconnecting drop. It was usually a matter of difficulty to get the two subscribers to talk with one another, and the operator had, as it were, to coax them along.

An early appearing difficulty with this class of switchboard was that the connecting strips running as they did from end to end of the switchboard took up an amount of space entirely disproportionate to their usefulness. Accordingly, they were later severed at one or more places, so that a number of connecting strips on the same horizontal plane might be severally connected to the same or different operators' tables.

Although the pin switchboard unmodified had not proved itself to be desirable, a new form of it was evolved during the year 1880, which considerably prolonged its lease of life. It was in desk form with a vertical part behind the desk, and in it the lines were represented by corrugated strips of brass mounted on edge, and crossed without touching by a number of other corrugated brass strips also mounted on edge; the connections of any two line strips with any one or two cross-strips being made by sheet brass connection plugs adapted for insertion at the intersections.

This switchboard was arranged in a number of groups, each to be presided over by a single operator performing all of the several functions in the connection of lines; and several cross-strips were assigned to her for local connections, while a certain number of others were extended to each of the other sections. An attempt about this time was made to classify lines by the trades, professions or vocations of the subscribers, but this failed by reason of the fact that it turned out that very few subscribers cared to communicate with others in the same business.

One horizontal strip of each group was connected with an earth branch including the telephones of the operator of such group, and another such strip was in like manner connected with the magneto generator of the same operator. Thus, by inserting a connection plug at the intersection of any line plate with the operator's telephone or generator cross-strip, and performing any other requisite operation, the operator might converse with the subscriber or send a call.

This switchboard was of low-initial cost, and was, therefore, suited to the times, for it had already been discerned that the income of a telephone exchange was not by any means all profit. It was, however, mechanically and electrically bad. It occupied considerable space and the electrical connections made by its plugs were imperfect. There is, indeed, a legend that an electrical engineer was visiting a certain central station, where this switchboard was exhibited with pride, and asked whether the plugs made good connections. When assured that they did, it is said that he blew at the switchboard with the result that some forty or fifty of the plugs were blown out of place.

Meanwhile it had dawned upon a number of the telephone men of the day that the separate call generator at each switchboard adapted for manipulation by the operator might be profitably superseded by a common generator supplying the entire central station, and having branches to each operator's position, and keys whereby the current might be transmitted over any line at will. This sometimes, and especially where power could not conveniently be applied, took the form of a calling battery supplemented by an automatic electromagnetic pole-changer, but was preferably an alternating-current magneto-electric generator, driven by any suitable power.

It will be seen that up to this time, indeed up to about 1884, there was no uniformity in switchboard apparatus, and there was no standard switchboard.

It had been ascertained by experience that the function of the central station was not merely to connect and disconnect telephone lines. It was far more complex. Calls were to be received, and signal-receiving appliances therefore were to be provided. Calls were to be answered and orders received, and for this purpose means were requisite to connect the operators' telephones with a call-originating line. Before connection could be established between a calling and a wanted line, it was essential to ascertain whether such wanted line might not be already engaged, and for this ready means of communication between the operators was necessary. If occupied, the fact had to be reported to the call originator. If not, a call signal had to be sent to the station wanted, and thus means for sending signals was also essential; and finally some device had to be rearranged for the indication and reception of ring-off signals.

Most of these appliances had of course been associated in a kind of haphazard fashion with switchboards from the beginning, but not until about this time was any attempt made to incorporate them in the switch apparatus as a definite part thereof.

Upon the commercial introduction of the multiple switchboard, which, though invented as early as 1879, did not obtain general acceptance until about 1884 or 1885, it seemed that the time for organizing these several devices into a complete and self-contained machine had arrived.

The thought underlying this type of apparatus is that the entire switchboard shall be divided into sections of suitable magnitude, and that each telephone line entering the station shall pass to every section and be furnished at each with a switch socket, so that at each section any

two of the entire number of lines may be united for through communication. As practically worked out, the call-receiving indicators of the whole number of lines were divided between the sections, and thus it came about that the call of a subscriber is always answered at some one section, and that switch connections in response to such call and between the calling and the wanted line are always made at the section where the call has come in and been answered.

There is no truth, however, better established than this, that each radical advance in electrical apparatus involves and paves the way for a number of subsidiary devices. And so it was here. The very fact that all of the incoming substation lines were represented by switch-sockets, and were accessible at each of a plurality of switchboards or switchboard sections, rendered further invention imperative. It became absolutely necessary to provide some means whereby the operator at any one of the sections could quickly find out for herself whether a line called for was or was not "busy." Accordingly, such means were devised. Without a "busy test" the multiple switchboard would be little better than a theory. Provided with a busy test system it becomes the practical basis of continued subsequent improvement.

Nearly all practical "busy test" arrangements provide that the insertion of a switch-plug into any one of the switch-sockets of any line at any switchboard shall bring about some electrical change which can be tested for, and detected at all of the other switch-sockets of the same line. If found to be present, the operator infers that such line is busy, but if when tested for such change be not manifested, the line is free and may be switched.

Scores of "busy test" arrangements have been proposed, but few are really practical. In that which was associated with the earlier multiple switchboards, the socket frames of every line were represented on the face of the board by a metal ring surrounding the plug-hole; and all the metal rings of all of the sockets of each line were permanently united to one another by a wire running along at the back. The shank of the switch-plug was also wholly of metal, and when inserted in the socket of any line at any board it acted to establish a conductive connection between the telephone line proper and the conductor uniting the metal rings, thus grounding the latter, since the telephone line was grounded at the substation. A small battery was included in circuit with the operator's telephone at each section operator's position, and keys were provided whereby the telephone might be looped into any of the switch-cords, a number of which were placed at each position. Thus to test at any section for the ground, cross, or other abnormal condition, which would indicate that a wanted line was engaged at some other section, it was merely necessary to touch the tip of the switch-plug to the metal ring (hence termed the "test ring") of the socket, which at such section represented the line called for. Should the wanted line be busy, a portion of the current of the small battery would pass by way of the test ring and the tip of the plug through the operator's receiver and produce a clicking sound therein; but if the line when thus tried were disengaged, no such sound would be heard. In the multiple switchboard of that period, the jacks or sockets of the lines at each section were arranged in panels over the front of the board; the call devices were annunciators

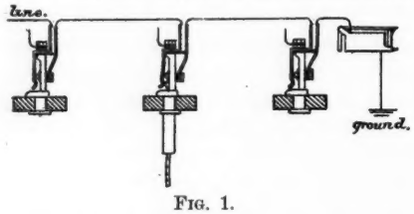


Fig. 1.

arranged in banks below these panels; the switch-cords with plugs at each end hung from a kind of gallows frame above, and on a keyboard in front of the operator were keys associated with the several switch-cords, respectively, for directing the call current over any line switched to any particular cord, and for similarly connecting the operator's telephones in the circuit of any cord to answer calls, and to talk with either subscriber. The disconnecting annunciators, one for each switch-cord, were mounted on a single row at each section. The circuits were of the single-wire type with earth return; the switch-sockets of the several lines—one for each line at each section—each had a spring and point contact, and these contacts, as indicated in Fig. 1, were all in series in the line.

As arranged for the switchboard of that period, the operators' telephones common to all cords of the section, were connected in an earth branch of the cord conductor, and the disconnecting annunciators, one for each switch-cord, were each connected directly in the circuit of its own cord. Fig. 2 indicates this arrangement.

Switchboards of this general type were installed for several years—the first one employed in New York being placed in a central office in John street—and in general were clear improvements over everything preceding them, and among other features of advantage they greatly increased celerity in operation.

The disclosure, under operative conditions, of faults, weaknesses and opportunities for improvement was, however, inevitable, where the engineers of both manufacturer and user were constantly on the watch. It was very soon observed that the manipulation of switch-cords hanging from a point above, was a strain upon the operators, besides being in other respects inconvenient, and soon their position was changed, and the plugs were made to rest with the calling and listening keys on the keyboard, the cords hanging below with a weight for each, to keep it taut, and for its automatic retraction. Then it was noted that the speed of operation was restricted because on the receipt of a call signal, the jack of the line, the call of which was to be answered, had to be found in the panel where it and adjacent numbers were placed, and to the avoidance of this defect, the next improvement was directed. There was provided for each line at the section where its calls were answered, an additional switch-socket to be used for the answering plug of a pair, and in responding to calls only. This was termed the "answering jack," and was placed close to the call signal of its own line. Switch connections were greatly facilitated by this expedient because whenever a call was received the operator was not required to take thought, but might at once plug into the answering jack which was close by.

After some four or five years' use of grounded circuit multiple switchboards it became evident that the time for the inductively neutral metallic circuit had arrived. One multiple board, the largest thus far constructed, had been set up and wired for grounded circuits, but so clearly was it seen that to proceed further in that direction would be a mistake, that this board was not put into operation until it had been completely rewired for metallic circuits. This advance was a radical one, and followed the introduction of underground wires, almost as a matter of course. The series mode of arranging the spring-jack contacts was at this time retained, these being in one conductor, while the other main conductor was connected by parallel branches to the test rings of the circuit at the several sections respectively.

In this arrangement which is shown in

Fig. 3, the call annunciator was connected on the answering-jack section between the two main conductors, the normal circuit through it being opened by the separation of the jack contacts when the switch-plug was inserted. This step in the onward progress of the switchboard carries one or two auxiliary improvements in its train. The operators' telephones and clearing-out annunciators were no longer connected alternatively in series in the cord conductors, but after a few tentative arrangements, were bridged between the cord strands, controlled, however, as before, by their several keys; but when thus placed, it became necessary to wind the disconnecting annunciator with many turns, and thereby give it a high resistance and impedance, as otherwise the voice currents from either of two circuits switched together, tended to be shunted through the bridged signal device.

The switchboard had now become a really good and homogeneous machine, well adapted to satisfy the conditions and requirements of its own day, and here for awhile its development seemed to be stayed. Yet it was soon seen that there was abundant scope for further advance. New switchboards became old, and old ones older. Others though still new were employed in the soft-coal consuming cities of the Middle West. In all of these cases, and more particularly in those last named, the series-connected jacks developed high-contact resistance which materially weakened the loudness and clearness of conversation transmitted through the circuits concerned, and as the number of lines connected increased with marvelous rapidity, it was found that the switch-sockets occupied too much space on the face of the board, so that a considerable reduction in size soon became imperative, in order that the requisite number of switch-sockets might be crowded, without detriment to operative efficiency, into a given space.

The subsequent development of the telephone switchboard depended upon the outcome of three apparently parallel and independent, but really coordinate and gradually convergent lines of investigation, which were all about this time under consideration.

These investigations were directed toward:

(*a*) The further improvement of the switchboard apparatus proper, by abolishing the serially connected jack contacts, which, as indicated, were a prolific cause of imperfect service, and by substituting some form of construction wherein each subscriber's line, when switched to another, would have a clear, continuous and highly conductive path through the switchboard for the voice currents, together with such other changes as each progressive advance might render necessary.

(*b*) To do away, if possible, with the multitudinous transmitter batteries of the substation and operating room, and to substitute for them a common central source of transmitter current; for if this

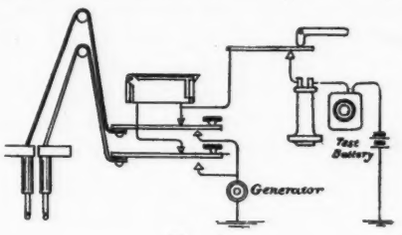


FIG. 2.

could be done, there would not only be effected a great reduction in the number of calls required, but such as were required might be kept at all times under the eye of skilled employés.

(*c*) To arrange if possible for the gradual displacement of the substation call generator, and the necessity for its

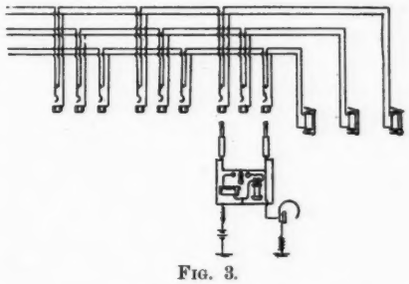


FIG. 3.

operation in the transmission of incoming call signals, to provide that call and disconnect signals should be automatically transmitted by the simple acts of taking the receiver from the hook switch, and restoring it thereto, and to devise suitable appliances at the central station for the appropriate display of these signals.

These several directions of prospective advance seem superficially to have little necessary community with each other, but the closer they are viewed, the more apparent will it appear that the realization of all would inevitably involve the complete reorganization of the switchboard, and that the efforts thus far devoted to the subject must be regarded henceforth as having resulted mainly in the determination of the principles which should be followed, and of what features were and were not desirable in an ideal switchboard. This was a well advanced position, and constituted a definite foundation on which the completely organized superstructure of an efficient modern switchboard might be successfully reared.

Considering first the direct improvement of the switchboard as a means for the rapid interconnection and satisfactory through operation of lines, it is sufficient to say with respect to the diminution in the size of the parts, that experience and practice had by this time enabled manufacturers to make spring-jack and other mechanism very small. The main problem was clearly the elimination of the spring-jack contacts. But how? Naturally, by arranging the switch-socket contact members at each section in parallel branches from both of the main conductors of their respective lines. But here was a difficulty, the serial spring-jack contacts were not by any means purposeless. The manifestation of incoming calls involved a subscriber's circuit, closed at the central office end, and an annunciator or similar call device connected in it, and the main purpose of the separable contacts in each jack was to ensure that while the spring member of such contacts which was on the lineward side should engage the inserted plug, the same should also be lifted by the plug tip from the fixed or insulated pin contact, thus opening the circuit at that particular socket, and cutting off all that portion of the circuit inwardly; that is to say, the original terminal including all following switch-sockets, together with the annunciator. Herein lay the difficulty, for if the insertion of the plug merely made contact with two branch springs, and did not sever the main conductors, how should the original terminal and annunciator be cut off?

It is of interest to note that the connection of multiple board jacks in parallel was not at this time a new idea. Indeed, the multiple board as first devised was on this plan, but as then suggested, the difficulty outlined did not occur, since the board in question was intended for use in association with circuits over which incoming calls were not sent (there being a special call circuit), which circuits therefore did not have a central station annunciator, and might be, and were left normally open.

Every telephone engineer had known almost from the inception of the art, that electromagnets indiscriminately placed in series in a telephone circuit strongly opposed the passage of the rapidly changing voice currents, making reproduction of speech weak and indistinct, and by this time Oliver Heaviside had coined the word "impedance."

(To be continued.)

Electrical Patents.

It has heretofore been customary in the manufacture of double cranks and shafts therefor to forge a piece of metal into the approximate required form, which embodied an enlarged solid eccentric portion which was afterward turned out to form the inner opposing faces of the crank-cheeks and the journal for the connecting rod. This operation involved a very slow and hence expensive process of turning and the waste of a large amount of material as well. A new process of manufacturing these cranks has been patented

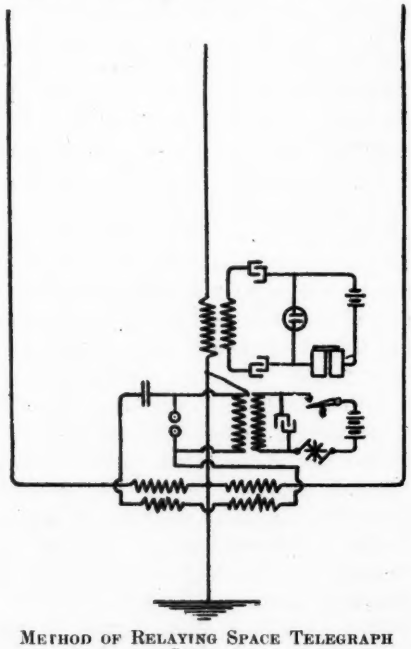
METHOD OF MANUFACTURING ENGINE CRANKS.

by Mr. John P. Brophy, of Cleveland, Ohio, who has assigned his entire interest to the Cleveland Machine Company. In carrying out this improved process, two duplicate members or elements are formed by drop-forging, each element having a cheek portion, a crank-shaft boss and a connecting rod journal boss. The thickness of the cheek portion and the diameters of the bosses are made somewhat greater than they are intended to be in the finished crank, and the combined length of the connecting rod journal bosses is made somewhat greater than the intended length of such journal in the finished crank. Each of the two elements or members is subjected to a turning or milling process, and its inner face—that is, the face contiguous to the connecting rod journal boss is finished off to a perfect plane at right angles with the journal-boss axis. They are then placed with the two journal bosses in juxtaposition on either side of a rigid block having two parallel plane surfaces. These two surfaces are located a distance from each other—that is, exactly equal to that which it is required the two inner faces of the finished cranks to be. The two elements are then moved toward each other until the journal-boss axis touch and a current of electricity is passed through such bosses of a character that will heat this to a welding heat. The approach is then continued until the inner faces of the cheeks contact with the adjacent faces of the blocks, the ends of the two bosses thereby becoming wedged into and welded to one another. The two crank-shafts are then welded upon the bosses, after which the shaft portions and the connecting rod journal are placed in a lathe and finished off to the required dimensions.

Mr. John Stone Stone, Boston, Mass., has secured some additional patents on his system of wireless telegraphy, the fundamental principles of which were described in the ELECTRICAL REVIEW of December 20. Two of these cover a method and apparatus for simultaneously transmitting and receiving space telegraph signals. If two similar vertical transmitting conductors have developed in them electric oscillations equal in amplitude and opposite in phase, electromagnetic waves will emanate from each, and at all points equally distant from the two vertical conductors these waves will be equal and opposite. Such points lie in a vertical plane equally distant between the two vertical conductors, and since the

METHOD OF ATTUNING VERTICAL WIRE OSCILLATORS.

electromagnetic waves from the two vertical conductors are throughout this place equal and opposite, their effect throughout the plane is nil. If, then, vertical receiving conductors be placed in this vertical plane, they will be unaffected by the oscillations developed in the two transmitting conductors. More than two transmitting conductors may be used, provided the amplitudes and phases of the oscillations be properly chosen. In using this system it is preferable to place the transmitting conductors so that the resulting magnetic waves are most powerful in the direction of the receiving station, which may be done by placing them one-half a complete wave-length apart and in a vertical plane, including the vertical conductors of the distant receiving station, as in this position the waves emanating from the two conductors will reenforce each other. Two other patents, covering a method and apparatus for relaying space telegraph signals, depend for their operation upon the same principle. By placing the receiving conductor between the two transmitting conductors this can be used to operate a local circuit, by this means repeat through the two transmitting conductors, which are so arranged as not to interfere with the receiving conductor and the message received by the latter. Another patent of this series, for relaying space telegraph signals, depends for its operation upon the tuning of the receiving and transmitting conductors. These are so tuned that the receiving conductor responds to but one frequency, which is different from that to which the transmitting conductor responds. The action of either of these conductors in no way interferes with that of the other, the message being received in one frequency and sent on in a different one. Two other patents to the same inventor cover a method tuning vertical wire oscillators and the apparatus for this. This is done by surrounding the conductor with a sheath formed of a medium of greater permeability than the air, but not conductively connected with the conductor, and by balancing the increased inductance thereby obtained by a suitable capacity. This may be accomplished by surrounding the wire by an insulated covering, about which is arranged a paramagnetic sheath, circumferentially continuous, but longitudinously discontinuous. This may then be covered over by another layer of insulation. Another patent of this series relates to an apparatus for determining the direc-



METHOD OF RELAYING SPACE TELEGRAPH SIGNALS.

tion of space telegraph signals. For this purpose the energy of the waves is received in several conductors, which may or may not be so connected as to form parts of a closed network. The oscillations thus received are conveyed to a suitable translating device. By changing the position of the several conductors relative to the direction of motion of the electromagnetic waves until the position is found at which the combined effect upon the translating device of the several oscillations is nil, the two conductors will then lie in the plane of the translating device.

INDUSTRIAL ELECTROCHEMISTRY AND ELECTROMETALLURGY—III.

Notes on Progress in Europe and America.

BY JOHN B. C. KERSHAW.

Nickel Production in Canada.

A correspondent who signs himself R. D. W., in a letter published in *Engineering*, London, on November 14, 1902, gives some interesting facts relative to the production of nickel ores in the Sudbury district of Canada, and smelting operations at Sault Ste. Marie. The pure nickel ore is shipped to Sault Ste. Marie, where, after roasting to remove the sulphur, it is pressed into briquettes. These briquettes are intended for use in the ordinary blast furnace with iron ores, the percentage of nickel in the resultant pig being thus determined by the relative weight of nickel ore charged with the other raw materials. The blast-furnace plant is not yet ready for operation, and the nickel ore briquettes are being stacked in large quantities. The nickel ores containing copper are roasted and smelted at the mines, a copper nickel matte being obtained containing sixteen per cent nickel and eight per cent copper. A bessemerizing plant for removal of the iron and other impurities from this matte is now being erected, and it is intended to complete the cycle of operations by the erection of a large electrolytic refining works at Sault Ste. Marie. The writer of the letter I have been quoting gives no details of this electrolytic process, but I believe that a method of separating nickel and copper, patented in the name of Titus Ulke, is to be used. It would also appear that the Clergue electric smelting process, by which ferro-nickel was to be obtained by one operation from the nickel ores of this district, is not to be employed in these later developments, and it would be interesting if the writer of the letter had given the reasons for this change of plans.

New Water-Power Centres in America.

The development of new centres of electrochemical industry is proceeding rapidly in America, and although Niagara still remains the most important example of water power applied to the conduct of chemical and metallurgical operations, there are signs that in course of time the Massena and Sault Ste. Marie power developments may rank second and third in magnitude and importance. The developments at Massena have been hindered by financial embarrassments, due to neglect on the part of the promoters of the original company to organize the industrial side of the undertaking; $10,500,000 has been expended, and a 50,000-horse-power generating plant has been installed. Foreclosure proceedings on the part of the debenture holders have been followed by a reorganization of the company and the issue of new shares. The industrial position will, it is hoped, now rapidly improve, for the Pittsburg Reduction Company has bought land at Massena and has arranged to commence the manufacture of aluminum on a large scale. A short illustrated description of these new works appeared in our columns on September 20, 1902. At Sault Ste. Marie the power developments are now likewise completed, and $5,000,000 has been expended upon a power plant of 40,000 horse-power.

The new power-supply canal was formally inaugurated on October 25, 1902. The total power available at the "Soo" is 60,000 horse-power, and in time it is probable that the locality will become a centre of flourishing chemical and metallurgical industry. At present, the factory of the Canadian Electrochemical Company, which manufactures alkali and bleach by the Rhodin process, is the only representative of the new industries, but a nickel refining works and a calcium carbide factory are planned, and the first of these is in course of erection. Shawinigan Falls, in Canada, is a third centre which is rapidly growing in importance; 18,000 horse-power has been developed here at the comparatively low capital cost of $600,000. An aluminum reduction works and a wood-pulp factory are at present the chief users of the power available. Recent information from Montreal indicates that the surplus power is to be transmitted to that city by a bare overhead aluminum conductor.

The Electrical Production of Iron and Steel.

The reduction of iron ores and direct production of steel in the electric furnace are now attracting some considerable attention, and experimental work in this direction is at the present moment being carried on at a large number of places in Europe, and at one or two in America. The slump in calcium carbide values in Europe is the chief cause of this activity on the part of electricians and engineers in relation to iron and steel, for in France and Switzerland a very large number of carbide plants have been shut down and much water power is running to waste in these disused works. If the production of iron and steel in the electric furnace should prove successful from an economical point of view, it will be a comparatively simple matter to adapt the furnaces in these idle carbide works to the new manufacture. The Stassano is the best known of the furnaces and processes now being experimented with, and it is "reported" to be in operation on a considerable scale at Pontedecimo, near Genoa, in Italy. Conley, Harmet, Herault, Keller and Kjellin are other electrometallurgists who have studied this application of electricity, and have patented processes and furnaces which are now undergoing trial on an industrial scale. Up to the present time little reliable information has been published concerning the efficiencies of these processes from a thermochemical point of view. The most detailed figures yet published have related to the early trials with the Stassano process in Italy. These showed that 2.7 electric horse-power-hours were required per kilogramme of metal produced, and that in Italy the electric power required for one metric ton of iron and steel would only cost eighteen francs, or $3.10. Two and a half years ago, in the *Electrical Review* (London), I submitted these figures and estimates to a careful examination, and I expressed the following opinion:

"It is, therefore, improbable that the electrical method of iron and steel production will enter into competition with the older blast furnace method of manufacture in countries where fuel is reasonably cheap, and the Stassano process is only likely to prove successful at present in countries where fuel is expensive, water power abundant and heavy protective tariffs on iron and steel exist."

Nothing has occurred during the last two and a half years to lead me to alter the wording of the above opinion, and I fear that those who are sinking both money and hopes in the present experiments are doomed to disappointment.

The regenerative gas furnace and the blast furnace are the most efficient heating appliances used in industrial operations, and electricians can only hope to displace them by electric furnaces when coal and coke have become comparatively scarce and expensive—*i. e.*, in another fifty or one hundred years. As practical illustration of the truth of the above remarks, I may add that the Italian company which was experimenting with the Stassano process is stated to be in liquidation. (See *Zeits. f. Electrochemie*, January 23, 1902.)

French Wireless Telegraphy Commission.

The Minister of Commerce, France, has appointed a commission to examine into the question of establishing a bureau of wireless telegraphy. The commission consists of M. Berrard, assistant secretary of state, and members from the bureau of commerce, ministry, telegraphy, foreign affairs, colonies, war, interior and arts, marine and public works.

Reviews of Current Engineering and Scientific Literature.

Giving Concisely the Substance of Important Papers in the Scientific, Electrical and Engineering Press of the World.

Paris Exhibition of Automobiles.

The exhibition of motor cycles and automobiles recently held in Paris gave an admirable illustration of the activity which is being displayed in this industry. A large building, the Grand Palais, was crowded with stands showing all types of machines and accessory gear. A special feature of the exhibition was the large quantity of motor cycles which it contained. Most of the machines exhibited were fitted with hoods and awnings for increasing the comfort of the occupants. Uncovered vehicles are now the exception. The outward appearance of the cars shows much improvement, and some important modifications have been made in the under frame which increase the strength of the car and do away as much as possible with skidding. The wheel base has been increased considerably, and the gauge has been made wider, being now from fifty-one to fifty-five inches. The driving motors were almost always fitted to the front of the car. They contain generally four cylinders, although some three-cylinder motors were exhibited. The arrangements for circulating and cooling the cooling water have been improved. One type, which has been used by various manufacturers and is known as the "beehive" radiator, is placed vertically in front of the car and is enclosed in a perforated casing. This arrangement gives a very large cooling surface. The engine valves have attracted much attention, different manufacturers being divided on the question of mechanical control. Although mechanical control adds to the complexity of the machine, this is compensated for by the absolute regularity in action of the admission and exhaust valves. These valves also enable the control of the motor to be almost as effective as in the steam engine. The standard ignition device is the magneto generator, though some makers prefer accumulators, charging these by a small belt-driven generator. Much progress has been made in the means of power transmission, and direct driving for high speed is often employed. The tendency is to do away with gearing in transmitting the movement of the motor to the wheels. Transmission shafts with universal joints are often used. Chain driving is being steadily abandoned, and the use of the belt is almost obsolete. No new features in brakes were exhibited, except that they were more powerful. Lightness in construction, combined with increased power, is generally the direction of improvement—in other words, a reduction in the proportion between dead and useful weight, combined with higher efficiency. Much still remains to be done, especially in the construction of the electric automobile.—*Abstracted from Engineering (London), January* 9.

Incandescent, Nernst and Osmium Lights.

This is an unsigned description of a series of tests conducted on the osmium light. The chief difficulties encountered by the manufacturers of this type of lamp are the high cost of osmium, its low resistance, making it suitable only for low-voltage circuits, and its weakness, making it necessary to support the filament at several points. Up to the present time it has been impossible to make lamps for more than forty-five volts. In spite of these objections, the use of the lamp has increased because of its high efficiency. Where the potentials of the distributing circuits are sixty-five volts or over, two or more lamps, as may be necessary, are connected in series. In form, the osmium lamp is not different from the usual incandescent lamp. The tests here described were made on nine twenty-five-candle-power lamps, which were connected in three sets of three lamps in series on a 104-volt circuit. The lamps were run for 275 hours, and the results are given in a table. These include readings of the horizontal candle-power for each lamp, and the current voltage and energy taken by each, readings being taken every twenty-five hours. This table shows a gradual increase in energy and a decrease in candle-power for all the lamps. At the end of the run the lamps were still in fairly good condition, the loss in candle-power being about twenty-five per cent, the energy increasing from 1.53 watts per candle to 1.95 watts per candle. A comparison is then made with incandescent lamps, using a carbon filament, the Nernst lamp and the osmium lamp. The incandescent lamp taken was a 120-volt lamp giving twenty-five horizontal candle. The average consumption is given as 3.2 watts per candle. The depreciation charge for 300 hours is taken as 8.4 cents. With electrical energy at sixteen cents per kilowatt-hour, the average cost per candle-hour is found to be 0.05 cent. The figures for the Nernst lamp are as follows: A 130-candle-power, 220-volt Nernst lamp, 2.05 average watts per candle; depreciation charge for 300 hours, fifty cents, costing 0.035 cent per candle-hour. For the osmium lamp the figures are as follows: A twenty-five-candle-power, thirty-seven-volt lamp, 1.65 average watts per candle; depreciation, $1.25 for 300 hours; average cost per candle-hour, 0.043 cent.—*Abstracted and translated from Electrotechnischer Anzeiger (Berlin), December* 14.

Cost of Stopping.

Mr. R. W. Western has examined the expenses, actual and implied, involved in the stopping and starting of a street railway car. These expenses come under two heads—those associated with the cost of mechanical energy destroyed, and those implied in the loss of time. Since in stopping the car its kinetic energy is dissipated by wear and tear, it is not unjustifiable to assume that the proportion of maintenance and dilapidation upon the parts concerned ascribed to stoppages, is the same as the proportion of energy expended upon them. Considering a concrete case, a car weighing six tons and moving at ten miles an hour, it was found that the energy required to run the car one mile is equal to that absorbed by fourteen stoppages. Knowing the operating costs per mile, the cost per stoppage can then be determined. The value of the time lost in stopping is found as follows: From the general charges for office and depreciation a figure can be found, giving this per car per minute. Knowing the total number of miles per car actually made, and computing the number which could have been made had there been no stops, the lost time can be found and the figure representing these charges can be divided between the running time and the lost time. Besides the cost of interest during the delay, the loss of time to other passengers should be considered. One passenger who stops a car carrying forty others to save himself the three minutes it would take him to walk to the nearest stopping place causes a loss of fifteen seconds to each passenger, or ten minutes in all, the ultimate loss being seven minutes. The average cost to the

company of stopping the average car is probably about half a cent, and it is difficult to avoid the conclusion that it would be profitable to encourage the use of regular stoppages, and discourage the use of casual stoppages. It is suggested that it might be worth while to try the plan of charging a minimum fare of half a penny to and from stopping places, and increasing this to one penny for passengens who stop the car elsewhere.—*Abstracted from the Tramway and Railway World (London), December.*

Soft Steels Used in the Construction of Electrical Machinery.

This note by M. George Charpy gives a brief review of the means which are now used for studying the magnetic and electrical properties of steel. The properties usually examined are the resistivity and permeability, and the hysteresis coefficient. During recent years a systematic method, which may almost be called a science, has been developed, and has been given the name metallography. In this study samples of the metal are examined with a microscope, and it is thought that this is the best as well as the quickest method of determining the properties of the metal. Industrial metals are never pure. Metals having identical chemical compositions may be very different. Thermic treatment modifies considerably the chemical distribution and the geometrical construction. Mechanical operations naturally cause deformation and often rupture of the elementary parts. Considering the special case of steel: A pure steel is formed almost entirely of iron and carbon. Annealing at a high temperature, and cooling slowly, grains are formed, probably of pure iron surrounded by a body formed of interlaced threads of iron and carbide of iron. This is called perlite, and as it contains all the carbon, it is naturally in proportion to the amount of that element contained in the metal. Microscopic examination shows a very different and characteristic structure of the steel when treated in various ways and when other elements are present. Tempered steel shows a surface composed of very small, irregular grains. Upon annealing, crystallization takes place, giving large grains interspersed at places with small ones, the condition of the specimen of course depending upon the method of annealing. If aluminum is present in the iron, the small grains are almost, if not entirely, absent. When worked mechanically these large grains are deformed and show very irregular structure. Conductivity appears to be an additive property—that is to say, it depends upon the different constituents of the metal, or the total conductivity is the sum of the partial conductivities. M. H. le Chatelier found that the resistivity of annealed steel increased 1.2 microhms for each additional per cent of carbon. As the grains of iron are more magnetic than the perlite surrounding them, they act as small isolated magnets in a magnetic medium. These grains may then be considered as elementary magnets, substituting them for the molecular magnets assumed to exist in Ewing's hypothesis. The energy absorbed in the mutual reaction of these magnets is a function of their number, so that it would be natural to expect a treatment such as annealing, which decreases their number, will improve the magnetic properties of the metal. This is known to be the case. These microscope examinations, not only give us a true idea of the properties of steel, but in certain circumstances may be used to estimate these properties. The author gives tables of results, and calls attention to the value of the study of steels containing silicon and aluminum. Some remarkable samples were found, which gave values much better than those in ordinary use, but which were not equal to the samples recently described by Messrs. Barrett, Brown and Hadfield. The author's samples were, however, prepared in quantity, and the differences are attributed to this fact.—*Abstracted and translated from Bulletin Société Internationale des Électriciens (Paris), December.*

Works of the Central Electric Supply Company, London.

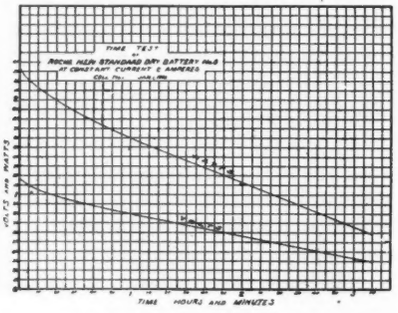
This gives a description of a new London generating station which was put into service a few weeks ago. As yet the plant is not completed. Current is generated at 6,000 volts, three-phase, this being the pressure delivered at the terminals of the dynamos, no step-up transformers being used. It is distributed by three-core underground cables to three stations of the Westminster Electrical Supply Company and the Carnaby street station of the St. James & Pall Mall Electric Lighting Company, where it is converted into continuous current for distribution. The conversion from high-voltage alternating current to the direct current at 400 volts for the Westminster system, and 220 volts for the St. James station, is effected without the use of step-down transformers, the motor-generator sets, consisting of an induction motor driving a direct-current generator, taking the full pressure. The generating units are Willans-Oerlikon sets. There are at present one 780-kilowatt machine and two 1,560-kilowatt machines installed. The complete equipment of the station will include two more of the larger units and two of the smaller size. The total capacity of the station will be 8,580 kilowatts. The engines are of the Willans type, and were furnished by Willans & Robinson. They are triple-expansion three-crank machines, with a central valve, single-acting type. The generators are three-phase Oerlikon machines running at 180 and 230 revolutions per minute, respectively, and having a frequency of forty-six cycles per second. They are of the revolving field type, with exciters on the main shaft. The boiler equipment consists of eight vertical Climax boilers, furnishing steam at 200 pounds' pressure. For local service at the station two large two-pole Siemens generators are provided, driven by 240-horsepower Willans engines. These generate continuous current at 200 volts, which is used for lighting the buildings and operating the cranes, coal conveyors, etc. Current can also be supplied by these machines for exciting any of the alternators in case of accident to the proper exciters. There is, further, a charging set, consisting of a synchronous motor driving a 200-volt continuous-current machine and booster for charging batteries. This set is primarily used for charging the mains before they are connected to the alternators, the continuous-current machine being run as a motor for this purpose. Current is taken from the small alternator terminals through a transformer, and brings the mains up to pressure. The small machine is then synchronized with the large alternator, and the main is switched on. Each of these machines has a capacity of sixty kilowatts. The article gives some interesting illustrations of the switchboard in progress of construction. The switches are of the six-plunger Siemens & Halske high-tension type, worked from a lever in front of the board. The fuses are enclosed in glass cylinders divided into four partitions by paper, each quadrant containing a fuse strip, and the four being connected in parallel. There are twelve cables leading from the station, all three-core 0.15 of a square inch cross-section. They are paper insulated Callendar cables, lead covered, armored with galvanized steel wires 0.1 in diameter, laid solid in iron ducts.—*Abstracted from Electrician (London), January 9.*

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

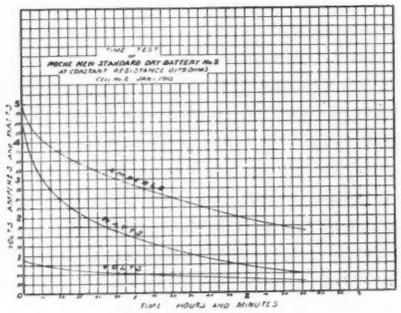
New Standard Dry Battery Tests.

In order to provide more comprehensive data for the benefit of the engineering profession, Mr. William A. Roche, 42 Vesey street, New York, has had numerous tests made upon some of his types of battery, with the idea of display-



CURVE SHEET No. 1.

ing in a thoroughly concise form their energy-producing qualities. Curves resulting from these tests are quite interesting, and some of them are submitted herewith. The cells whose tests are illustrated by the following curve sheets are known as the Roche new standard dry battery No. 5. The weight of these cells is two pounds. Their internal resistance averages about 0.12 ohm, their voltage is rated at 1.52, and on short-circuit these cells will give from fifteen to eighteen amperes.

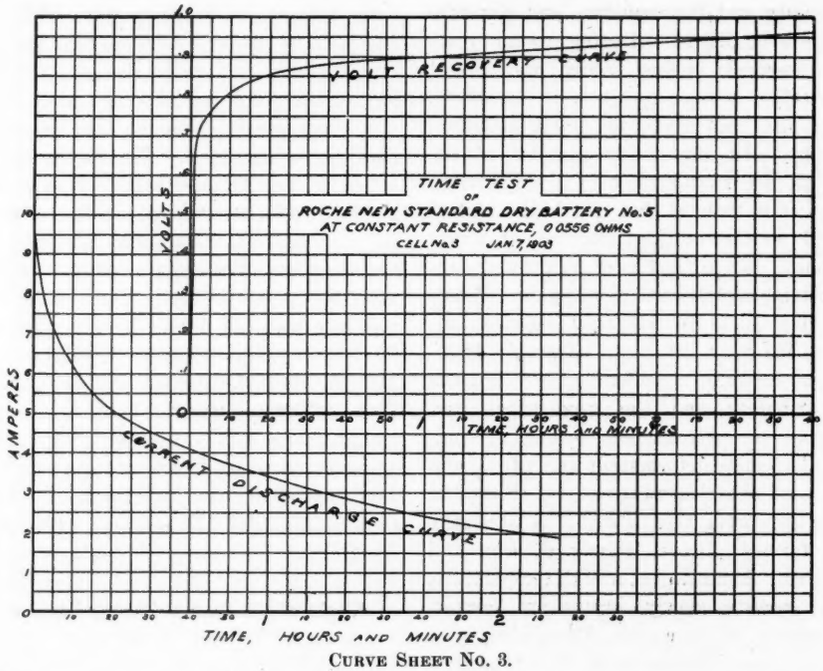


CURVE SHEET No. 2.

Curve sheet No. 1 displays the performance of one of these cells discharging through a resistance which is varied so that the current will always be two amperes. It will be noted that the starting voltage with resistance in circuit was 1.18, and that it required nearly three hours and ten minutes to reduce the voltage 0.3, the voltage falling off almost uniformly with respect to time. On releasing the cell from the test the voltage rapidly recovered, and in twelve hours the circuit voltage had returned to 1.20.

Curve sheet No. 2 gives the discharge curves of the cell through 0.179 ohm. The current started at five amperes, and at the close of the test was slightly over two amperes, it requiring a little over two hours and thirty minutes to reduce it to this condition. The voltage of the cell on open circuit quickly recovered within twelve hours to 1.20 volts as in the former case. The watt-hours per pound of cell on a three-hour test was a little over 2.3. The gross weight of a cell was two pounds.

Curve sheet No. 3 is interesting, as it shows the behavior of the cell on a heavy



CURVE SHEET No. 3.

short-circuit, and its subsequent recovery. The cell was short-circuited through 0.056 ohm, and starting with ten amperes the current fell off until at two hours and fifteen minutes it had reduced to a little below two amperes. On releasing the cell from its load, the open-circuit voltage almost immediately jumped to 0.7 of a volt, and after that by slower increments it rose within an hour and forty minutes to 0.965 volt. This curve should be of interest to those who employ dry cells for the purpose of bell and telephone work. It shows that such a cell could endure a very severe short-circuit and almost immediately recover sufficient voltage to work any ordinary apparatus to which it might be connected.

In all three of these tests the voltage recovery is very prompt and is very noticeable in view of the fact that these cells are intended for intermittent work. In a subsequent test made on these cells on interrupted circuit, conditions that would obtain in automobile work being duplicated, the results were very satisfactory. The cell was first tested with a commutator in circuit, which closed the circuit one-third of the time. The cell when operated under this interrupted load ran for three hours and twenty-five minutes with rests between each hour period. The current was taken with the commutator at rest both before and after the test, as was also the open-circuit voltage. It was found that the current fell almost uniformly from 6.2 amperes to 5.2 during the period of the test, the open-circuit voltage falling proportionately.

Finding that this arrangement would make the test unduly long, the commutator was changed and another was substituted, closing the circuit one-quarter of the time. This subsequent test extended over a period of twenty-eight hours of running and sixty-nine hours and twenty-six minutes in rests, these rests being divided up at approximate hour intervals, the aim being to duplicate automobile conditions as much as possible. On the start of this second test the battery was able to force 4.2 amperes through its circuit. At the close of the test it was able to force 1.2 amperes through the circuit, the capacity for delivering current falling off practically uniformly throughout the run. At the close of the test the cell showed a marked and substantial tendency to recover its voltage and current-producing capacity.

Semi and Fully Enclosed Motors.

In designing these motors care has been taken to fashion them so that they will be very compact and well adapted to direct attachment to machine tools and machinery in general. The end-plate castings, which are bolted to the magnet frame and serve both as a protection to the armature and a support for the bearings, are constructed so as to secure great rigidity, and the shafts are made very stiff; these features being essential to motors that are particularly intended for gear driving.

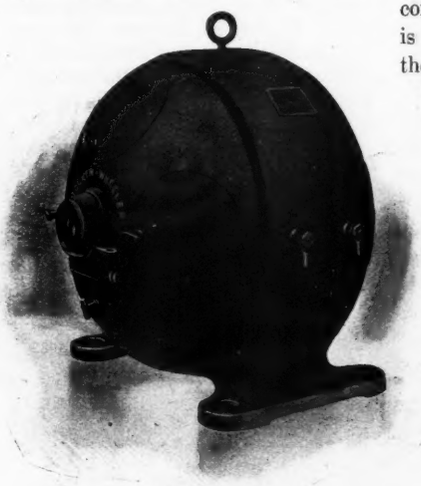


FIG. 1.—FULLY ENCLOSED MOTOR.

This line of motors comprises three types. The fundamental and most used type is the semi-enclosed, in which the vital parts are sufficiently protected from injury which might be caused by a large body striking them, and yet are provided with sufficiently large openings for good ventilation and access to the internal parts. In cases where the motor is exposed to flying metallic or other particles some or all of these openings are protected with metal gauze covers. In the fully enclosed motors the openings are covered by tightly fitting covers of thin malleable iron.

Fig. 1 is a fully enclosed motor, and is typical of the design of this line, which is manufactured in eight sizes. The range of outputs for the semi-enclosed is from three to forty-five horse-power, inclusive. When the motors are gauze-enclosed or fully enclosed, the ratings for continuous service are reduced. Fig. 2 is an interior view of the motor, showing the method of attaching the end-plate.

The yoke of the motor is of cast iron, circular in form, with internal flanges machined to permit of the end-plates resting snugly against them. These end-plates are fastened by four bolts. The bolt holes are accurately spaced so that the plates may be revolved one-quarter or one-half a revolution, retaining the oil wells beneath the shaft when the motor is mounted on a wall or ceiling.

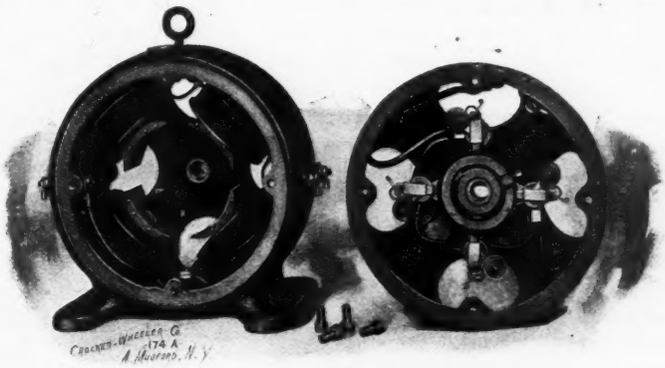


FIG. 2.—INTERIOR OF MOTOR.

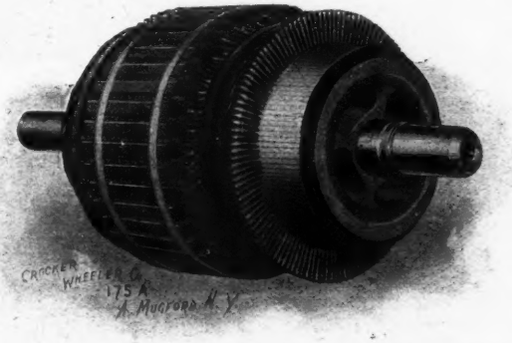


FIG. 3.—ASSEMBLED ARMATURE.

The motor is of the multipolar type, the field poles being cast into the frame. These are of circular cross-section. Pole shoes are bolted to the poles to hold the field coils in place. Coils are carefully wound and insulated, the outer surface being protected by a covering of heavy insulation coated with varnish as a protection against dampness and dirt.

The armature is built up of steel laminations of high magnetic permeability, properly insulated from each other. The laminations are securely keyed to the shaft in the small machines, and in the large machines are keyed to the armature spider. In either construction they are clamped together by insulated bolts in such a manner that the pressure is applied at a point near the slots. The coils consist of heavily insulated wire, form wound. After being taped they are dipped in insulating varnish and thoroughly baked, then carefully placed in the core slots, which are also carefully insulated. Fig. 3 shows the commutator end of an armature for a seven and one-half horse-power motor.

The commutator bars are made of the best hard-drawn copper, uniform in section and well insulated from each other and from the shell with mica. The shape of the bar below the surface is such that clamping rings at each end secure a rigid hold on every bar and retain them as a whole in true cylindrical shape. After these clamping rings are in place the bars are put under compression and baked, which gives them their true position and obviates the possibility of further shrinkage. The commutator tails are thinner than the bars themselves, permitting air

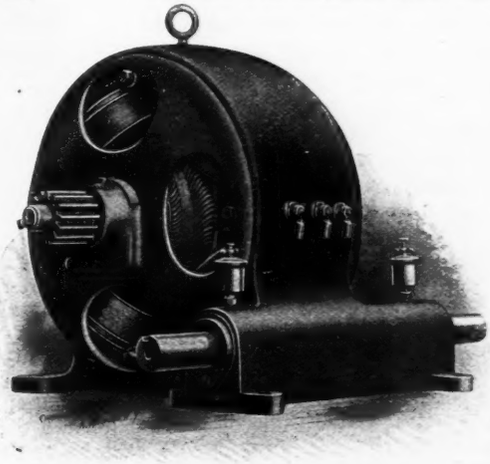


FIG. 4.—SEMI-ENCLOSED BACK-GEARED MOTOR.

currents to pass out between them and over the surface of the commutator, assisting in the cooling of both the interior of the armature and the commutator.

The shaft is made of machine steel, ample in section to carry the rotating armature without vibration. The journal boxes are rigidly supported within the end-plates. The end-plate is extended to afford two-bearing surfaces for the journal to rest upon, and furnishes the oil well. Oil rings resting upon the shaft and dipping into these reservoirs ensure positive lubrication. The oil is carried up on the shaft, works its way toward the end of the bearing, and is thrown off against retaining lips which force it back into the well.

The rocker arm rests in a groove on the inner end of the bearing support of the end-plate. A set screw firmly clamps this rigging when the proper position of the brushes has been fixed. The studs carrying the brush-holders pass through openings in the rocker, and are securely fastened and well insulated. Brushes fit snugly within a brush box, and are held firmly against the commutator by an adjustable spring.

These motors are shunt, series or compound wound, depending upon the service, and the connections are made accordingly. The cables from the fields and brush studs are led to the inner ends of studs which pass through the magnet frame to the outside, where connections are made to the starting box or controller. The studs are insulated by heavy porcelain bushings cemented into the magnet frame. The compactness of design, its protected form and convenient speeds and ratings render this motor especially adapted for use in machine-tool drive. When required, speed reduction is obtained at the motor by a countershaft whose bearings are cast as a part of the motor frame. The placing of this countershaft to one side of the frame, and near the base, gives it great rigidity. In this way reduction ratio up to eight to one may be obtained. Fig. 4 shows a semi-enclosed motor with countershaft and pinion.

These motors are manufactured by the Crocker-Wheeler Company, Ampere, N. J.

The *Graduate Bulletin* of the University of Nebraska contains an article by Mr. H. S. Evans on "The Electric Arc and Furnace." This gives a good account of the early study on the electric arc, and a critical examination of the reactions taking place in the furnace as used in different processes. Particular reference is made to the formation of graphite and the manufacture of artificial diamonds.

A Railway Motor for City and Suburban Service.

The accompanying illustrations will give a very clear idea of the interior design of a street railway motor for city and suburban service. This motor has a rating of thirty-seven and one-half horsepower, based on the usual shop test of seventy-five degrees centigrade rise at the expiration of one hour's run at full load. Attention might be called, however, to the excellent feature of the ventilation of this motor, and it is stated that the temperatures actually reached are much lower than those which might be expected in view of this rating. The frame is cylindrical in shape, divided horizontally into halves, which are held together by four bolts. On the side furthest from the axle there are two eye-bolts on the lower half, fitting over hooks cast in the upper half. The lower half can be swung down by taking out the two bolts nearest the axle, leaving it hanging on the two eye-bolts and their hooks, as may be seen from the illustration in Fig. 1. If it is desired to remove the lower half entirely, all four bolts are removed, and the lower frame dropped into the pit by suitable tackle.

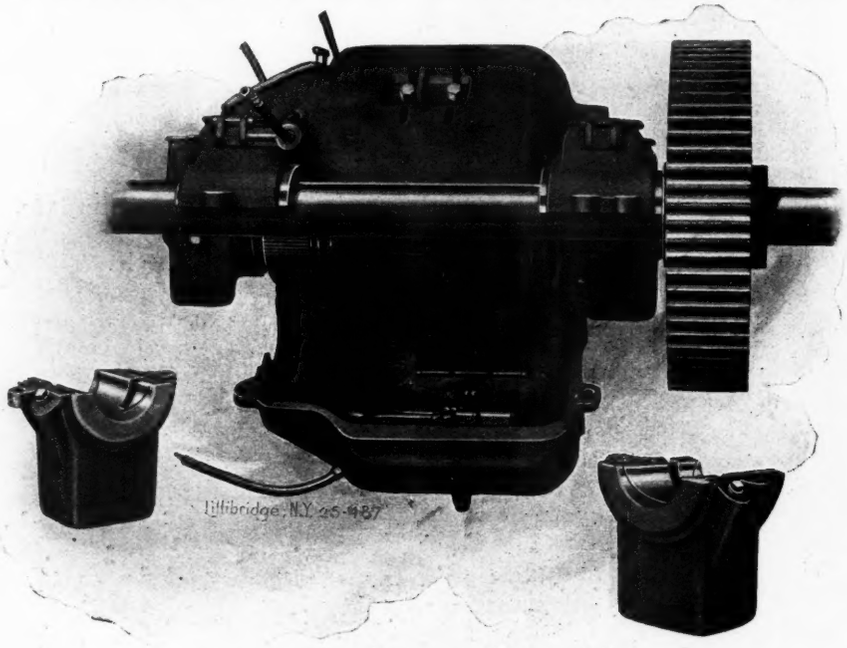


Fig. 1.—Interior of Street Railway Motor.

The pole-pieces are made up of soft laminated steel punchings, riveted together and attached to the frame by bolts passing through the frame and tapped into a large rivet in the centre of the pole-piece. Each pole has a flare, or offset, at the armature end, which, besides holding the field coil in place, also effects that distribution of the magnetic flux entering the armature, which results in the best commutation.

The armature bearings are babbitt-lined, cast-iron shells. These are of ample size, the commutator bearing being six and one-eighth inches long and the pinion bearing seven and three-quarter inches long. These bearings are held in place by bearing caps bolted to grease boxes cast in the upper half of the frame. The caps are so separated from the lower half of the frame that this may be removed, leaving the armature supported by the upper half. If desired, however, the caps may be removed before the frame bolts and the armature lowered with the lower half of the frame, as is shown in Fig. 2. The caps are deep and hollow and the bearings are kept lubricated by wicks bearing against the shaft. Grease boxes, fitted with spring-closed covers, are cast in the upper half of the frame and project over the bearings, furnishing additional source of lubrication in case the oil runs out or the bearing begins to heat from other causes. A space is left between the bearing cap and the frame, through which projects the oil guard on the armature shaft which prevents any escaping oil to reach the field or armature.

The field coils are wound of square wire thoroughly insulated. The design of the frame casting allows the use of a flat coil, making it unnecessary to bend the wire after it is removed from the former.

The method of bringing out the terminals of the field coils is a feature which is deserving of special attention. The inner end of each coil is attached to a flat flexible copper strip which is brought out through the insulation, and the strips from the adjacent coils are strapped together. The outer end of each coil is attached to a rubber-covered flexible wire several feet in length. These wires are brought out through appropriate holes in the frame and are attached to the car wiring on the outside.

The coils, after winding, are dried in an oven, and, while hot, dipped into an insulating compound which fills the

spaces between the wires and prevents the entrance of oil or moisture. The coils are then wrapped in layers of rope, paper, mica and tape, with leatheroid protection where there is a liability of chafing, and are finally thoroughly japanned and baked.

The armature is also of special construction, and is built with large ducts parallel to the shaft to allow the air to enter the body of the armature. Ventilating ducts, perpendicular to the shaft, allow the heat to escape from the interior of the iron. These may readily be seen by referring to Fig. 2. The armature and casting project above the level of the coils so as to protect the end windings from injury. The armature coils are form-wound, dipped and thoroughly insulated with oiled linen and tape. The band wires holding the coils in place lie in grooves below the general surface of the armature.

The commutator bars are clamped together in a jig with micanite insulation between, and baked to soften or remove the shellac or other cementing material. The clamping screws are then tightened and the bars drawn solidly together. The ends are then turned true to gauge and the insulating heads and end clamps fitted into place, after which it is again baked and the end clamps set up and locked into position.

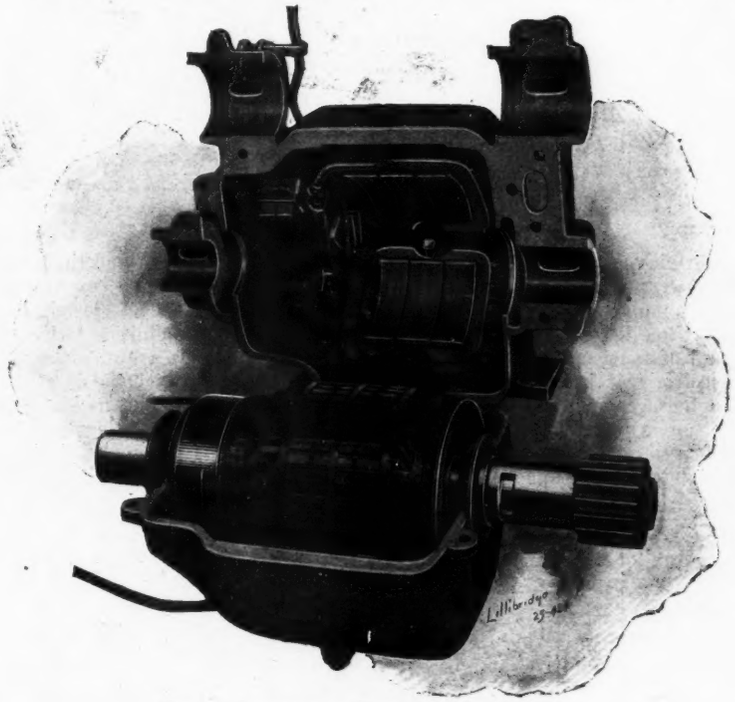


FIG. 2.—INTERIOR OF STREET RAILWAY MOTOR.

A cover over the commutator permits inspection and replacing of brushes. Another hand hole at the bottom of the motor allows inspection from below. This hole is fitted with a ventilated cover filled with a sponge, which prevents the entrance of dust, but allows for the escape of any moisture which may gather in the bottom of the motor.

These motors are made by the Stanley Electric Manufacturing Company, of Pittsfield, Mass.

Mechanical Oil Cup.

In a great many engine installations the demand is made for a positive mechanically operated lubricator, this method of lubrication being demanded by some engineers as more reliable than the lubrication which is obtained by hydrostatically worked lubricators.

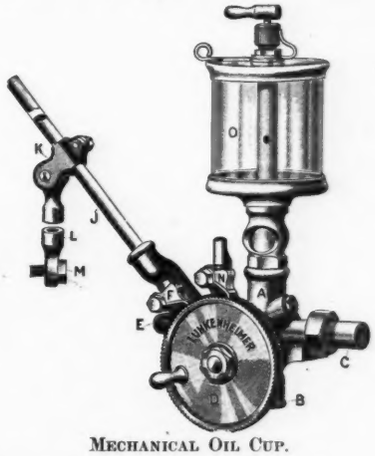
Referring to the illustration, the driving mechanism is of the ratchet type, operated by the clutches *f* and *n*, that work cooperatively by the motion of the rod, *j*, which can be attached to the eccentric rod or other moving parts of the engine by the couplings *k* and *m*. The motion thus obtained is transmitted to the piston, *e*, by the crank pin mechanism, *h* and *g*.

The ratchet wheel, *d*, is provided with a handle whereby it can be rotated by hand in case it is desirable to force a quantity of oil at any time, as, for example, when starting the engine.

By moving the part *k* up or down the rod, the length of the stroke can be lengthened or shortened as desired, thus regulating the amount of oil fed by the pump independent of the feed from the oil cup. The joints of the cup are tight, the sight-feed glass being packed so as to prevent an access of air that would have a tendency to cause the cup to feed after the engine had ceased running This construction and the use of check valves in the pump prevent the oil supply from flooding.

The outlet, *c*, is piped to the steam pipe or chest of the engine, and the spring check valve, *x*, should be placed as near the end of a pipe as possible, preferably into the steam pipe.

The bottom of the pump, *b*, is tapped one-half inch pipe thread to receive a



MECHANICAL OIL CUP.

stand, so that it can be placed wherever desired. This pump is substantially constructed, and the parts are made to jigs and templets and can be easily removed, the parts being interchangeable. The ratchet wheel, *d*, and pawls, *f* and *n*, are made of tool steel, tempered and hardened. All other metal parts about the pumps are made of hard bronze composition. This oil pump is made by the Lunkenheimer Company, of Cincinnati, Ohio.

New Type Electric Vehicles.

The Electric Vehicle Company, of Hartford, Ct., exhibited thirteen out of twenty different types of Columbia automobiles listed for 1903, at the recent Automobile Show held in New York city. The new Columbia four-cylinder gasoline touring car was conspicuous among the models shown. This will no doubt prove a notable addition to the various high-power gasoline machines on the market. The general lines are approximately those of all the successful French and German adaptations. A vertical water-cooled engine is carried in the forward bonnet, and the cooling water at the extreme front has radiating surface enough to maintain a constant low temperature in the water around the cylinders. The shaft drives directly to the countershaft, which is connected by chains with individually propelled driving wheels. The car is nominally rated at twenty horse-power, but the engine develops twenty-six actual brake horse-power. Four speeds ahead and one reverse are controlled by a single lever with safety locks, preventing any possibility of improper gear shifting. The clutch system is of entirely new design, and a new form of wheel steering is used. The seating accommodation is for five persons, and the body is supported above the axles by two full elliptical springs at rear,

and two half elliptical springs at the front. There are four brakes of the double band type.

The Columbia electric brougham has inside accommodation for four passengers in the extension-front pattern, while the straight-front pattern provides for two. The inside appointments of these vehicles are in accordance with the furnishings of the most modern horse-drawn broughams of the highest grade. The double-motor equipment gives four speeds forward and two backward, with a maximum speed of fourteen miles per hour. The controller is at the operator's left. The vehicles are steered by a wheel so arranged as to secure complete control under all conditions of city traffic. For braking there are foot-operated regular and emergency brakes, and a foot-operated safety cut-off switch. The battery consists of forty-four cells with a capacity of 145 ampere-hours at a thirty-five-ampere rate, affording forty miles on one charge.

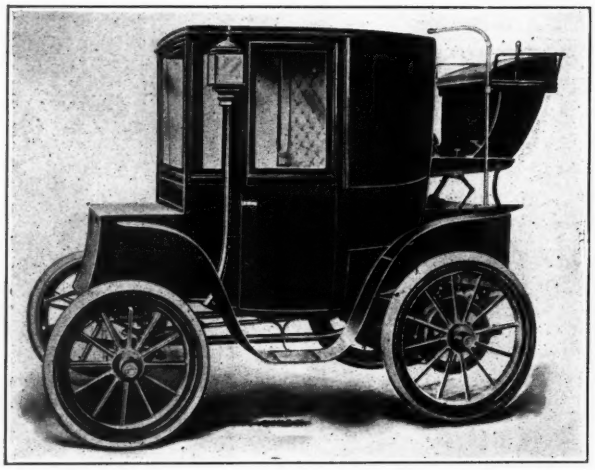
The electric hansom is a most elegant and thoroughly distinctive electric vehicle. This is shown in the accompanying illustrations. This hansom is designed for private service, and is elaborately equipped. The body design departs somewhat from previously existing models, the top being more commodious and having increased window spaces. The interior furnishings include mirrors, speaking tube connecting with driver's seat, pockets, and an incandescent lamp in dome fixture.

The inside-operated electric coupé dispenses entirely with the necessity of a separate driver. This vehicle is especially suited for physicians and others desiring a machine which may be used comfortably at all times without regard to weather conditions. The motors give three speeds forward and three backward, with a maximum speed of fourteen miles per hour.

The electric rear boot coupé, which is shown in the accompanying illustrations, combines on a smaller scale the distinctive features of both brougham and hansom types. The upholstering and other interior furnishings are very complete, and the controlling and steering mechanism is so arranged that there is every facility for easy operation.

The Columbia electric truck is the latest type of the Electric Vehicle Company's commercial vehicles. The chassis, which will accommodate any kind of a platform or body, is furnished in two sizes, having load capacities of 10,000 and 5,000 pounds, respectively. The running gear is of the reachless type, with a three-point body suspension. The truck in the accompanying illustration is of two and one-half tons' capacity, and has two motors, each developing a maximum of five horsepower. A special feature is the vertical controller operated by a small wheel beneath the steering gear. There are two powerful foot-operated brakes, the regular brake being of the band type, acting on the outside of the rim, and the emergency brake, of the internal expansion pattern. There is also an electric brake in the controller. In addition to these safety appliances there is a heel kick-out emergency switch, by which the current can be cut off instantly. The under-slung batteries are put in from below, and are held by an ingenious automatic device which reduces the trouble of changing batteries to a minimum. There are four speeds forward, of two, four, six and seven and one-half miles per hour, respectively, and three reverse speeds.

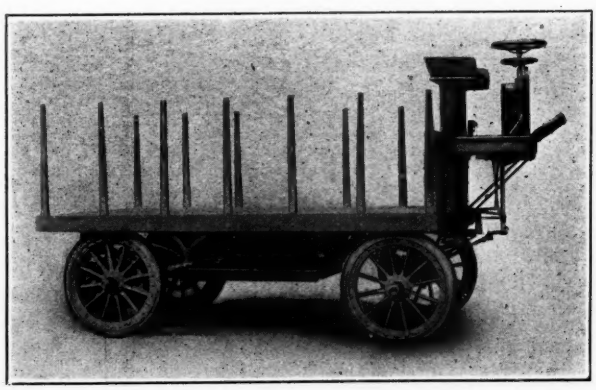
The Electric Vehicle Company also manufactures, with various improvements, the several Columbia models which have been successful in the past, including the cabriolet, surrey, opera bus, Mark XI delivery wagon, wagonette, police patrols, ambulances and other types.



ELECTRIC COUPÉ—OPERATED FROM REAR BOOT.

INSIDE OPERATED ELECTRIC COUPÉ.

NEW 1903 MODEL ELECTRIC HANSOM.



ELECTRIC TRUCK FOR HEAVY DELIVERY.

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

LIGHT AND POWER PLANT FOR HAWAII—The Waihailua Water Company, Hawaiian Islands, is now drawing up plans for the erection of a power plant at the falls of the same name, for the purpose of furnishing light and power. Two dams will be constructed and modern generating machinery will be installed.

TELEPHONE COMPANY INCREASES ITS CAPITAL—At a recent meeting of the stockholders of the Cumberland Telephone and Telegraph Company at Hopkinsville, Ky., it was voted to increase the capital stock from $10,000,000 to $20,000,000. The additional funds will be used for building new lines throughout Kentucky, Tennessee and other states, in acquiring property and in general improvements for the interstate system.

ELECTRICITY FOR MEXICO CITY—The Mexican Light and Power Company has been organized with a capital of $12,000,000, to develop a water-power scheme for Mexico City. It is expected that within two years it will develop some 40,000 horse-power in the Sierra Madre Mountains, ninety miles from Mexico City. The current will be generated at this point and delivered over high-potential transmission lines to the city.

AMERICAN TROLLEY ROAD FOR JAPAN—An American trolley system is to be operated between Kawasaki, Japan, and the temple of the Confucian god Daishi. This is a road twelve miles long, and for centuries it has been the scene of pilgrimages of remarkable numbers. Prominent American and European contractors are to undertake the work, and it is expected that it will be a profit-making institution from its first inception.

UNION TRACTION COMPANY'S PLANS—During the conference between the chiefs of the Union Traction Company, of Chicago, and Mayor Harrison, it was stated that the plans for improvements in the Union company's plant would entail an expenditure of about $40,000,000. The plans embrace a subway for the down-town district, and call for a thorough reorganization on lines similar to those established in New York city.

OHIO TELEPHONE COMBINE—Plans are now under way looking toward the consolidation of various prominent telephone properties in Ohio. The proposition is to organize in New Jersey a $10,000,000 corporation. The syndicate having the plans under advisement controls many important franchises in the northern part of Ohio, besides owning a number of lines already in operation. A franchise has been applied for in Cincinnati and it is expected that it will be granted.

PENOBSCOT RIVER POWER SCHEME—The Bangor (Me) board of trade has considered the question of utilizing the water power of the Penobscot River, and the decision has been that it is a favorable project. If the plan is generally received with favor, and a charter obtained, it is stated that the capital necessary for the financing of the operation will be immediately forthcoming. The plans involve an outlay of about $10,000,000, and it is expected that from 60,000 to 100,000 horse-power will be developed.

LARGE WESTERN TELEPHONE COMPANY ORGANIZED—A new $3,000,000 company has been financed in Topeka, Kan., for the purpose of connecting all of the larger towns of Kansas by long-distance telephone. The company is called the Western Independent Telephone and Telegraph Company, and will have headquarters in Kansas City. Lines connecting Kansas City with Wichita, Newton, Ottawa, Emporia and towns west of these with Abilene, Salina, Enterprise, and in fact with all of the large towns of the state are either in construction now or are projected.

CINCINNATI AND TOLEDO CONNECTED BY TROLLEY—Plans under consideration provide for the Cincinnati, Dayton & Toledo Traction Company, obtaining complete control of all the lines between these two cities, and then to turn them over to the Cincinnati Traction Terminal Company. The plans call for the control of more than 200 miles of trolley lines, and it is stated that these will be in operation within sixty days. The lines affected are the Cincinnati, Dayton & Toledo, the Western Ohio, and the Findlay & Toledo, with two small roads between Piqua and Dayton.

BALTIMORE RAILWAY SYSTEMS TO ENLARGE—The United Railway and Electric Company is getting ready to bring under its control over forty miles of additional track. For this purpose a special meeting of the stockholders of the company was called on January 26. The purpose of the meeting was to consider the lease for ninety-nine years of the property of the Baltimore, Sparrows Point & Chesapeake Railway Company. This is a corporation that will be formed by the consolidation of the Baltimore, Middle River & Sparrow Point Railroad and the Dundalk, Sparrow Point & Northpoint Railway Company.

MARCONI WIRELESS COMPANY FORMED IN CANADA—The organization of the Marconi Wireless Telegraph Company, of Canada, has been completed and a meeting of the shareholders has been held. The following gentlemen were elected directors: Colonel F. C. Henshaw, president; William Marconi, vice-president; Andrew A. Allan, Rodolphe Forget, Beaumont Shepard, secretary; Willard Reed Green, New York; John D. Oppe, representing Marconi's Wireless Telegraph Company, Limited, London (the parent company), managing director of the Canadian company. The Canadian company acquires the whole of the Marconi system in Canada and all of the property and rights of the English company, including the completed station at Glace Bay.

PERSONAL MENTION.

MR. A. FREDERICK COLLINS was a notable speaker before the Brooklyn Institute of Arts and Sciences last week. A large audience was greatly entertained and instructed by the demonstrations by Mr. Collins on the general subject of electricity and wireless telegraphy.

MR. F. L. HUTCHINSON, manager of sales of the Christensen Engineering Company, of Milwaukee, Wis., has been in Chicago, recently, establishing a branch office there. Mr. Hutchinson was well known in New York city and vicinity in connection with the C. W. Hunt Company.

MR. CHARLES M. WOOD is now actively engaged as president of the Century Electric Company. Mr. Wood for many years was connected with the California Electrical Works in San Francisco as manager of the sales department. He resigned this connection the latter part of 1902.

MR. E. H. BOUTON has resigned the presidency of the Maryland Telegraph and Telephone Company. Mr. George R. Webb succeeds Mr. Bouton in this appointment, and it is expected will succeed him also as president of the Pittsburg & Allegheny Telephone Company, which, it is announced, Mr. Bouton will resign.

MR. W. A. VAIL has been made general manager of the Northwestern Telephone Exchange Company, covering Minnesota and North and South Dakota. Mr. Vail will make his headquarters at Minneapolis, removing from Indianapolis, where he was located as special representative of the American Telephone and Telegraph Company.

MR. EDWARD S. FARROW has been appointed general consulting engineer of the Engineering Company of America, with headquarters at 74 Broadway, New York city. Mr. Farrow was tactical instructor at West Point and outside of ordinary engineering duty, has a remarkable record for gallantry and bravery in the Indian wars of the Northwest.

MR. B. B. ABRY, on the evening of January 22, delivered a lecture before the Westinghouse Electric Club on the subject of "The General Discussion of an Electric Railway Project." Mr. Abry has now charge of all the Westinghouse Electrical Manufacturing Company's experimental and research work on railway motors. Mr. Abry while yet a very young man, has made rapid progress in the engineering field. He is a good talker, with a ready command of his subject, and is also a fluent and capable writer.

TELEPHONE AND TELEGRAPH.

NORWICH, N. Y.—A telephone line will be built from Pitcher to DeRuyter *via* Lincklaen in the spring.

DAVENPORT, IOWA—The Hudson & Finchford rural telephone companies are contemplating a merger, with offices and central exchange at Cedar Falls.

DOVER, DEL.—The Diamond State Telephone Company has purchased the Sinepuxent Telephone Company, of Maryland, and merged the lines in its service.

AURORA, ILL.—The Interstate Telephone Company will erect a telephone building in Peoria, and will install an up-to-date system. All wires are to be underground.

ROXBORO, N. C.—The Morris telephone exchange is growing rapidly, and is now constructing lines all through Ferson County. Many improvements are to be made to the system.

McPHERSON, KAN.—A new long-distance telephone company has been organized with a capital of $3,000,000, with headquarters at Kansas City. The object is to connect all the leading cities of the state.

ATLANTA, GA.—On February 5, 1903, at twelve o'clock noon, the entire plant of the Atlanta Standard Telephone Company will be sold by the commissioner. This includes an elaborate switchboard equipment, pole lines, conduit and appurtenances in modern and first-class condition.

LOUISVILLE, KY.—The Cumberland Telephone Company, of Nashville, will greatly improve its service in the territory within a radius of fifty miles of Louisville. New lines and exchanges will be built in many places, and it is said a big part of the $2,500,000 increase in capital made by the company recently will be expended in this new work.

YORK, PA.—A charter was recently granted to the York Southern Telephone Company, of Cross Roads Borough, York County. The company was organized some time ago by local men, and its line is now in operation between Cross Roads, Felton and other towns in the vicinity. It has connection with the Pennsylvania Telephone Company.

JANESVILLE, WIS.—Articles of incorporation of the Footville Telephone Company have been filed with the register of deeds. The new company proposes doing business in Footville and vicinity, and will erect an exchange there. The company was incorporated by S. W. Lacey, A. E. Aspinwall, J. Meehan, T. W. Snyder, Walter Honeysett and W. O. Howell.

CLYDE, N. Y.—The city board of trustees has given permission to the Empire State Telephone and Telegraph Company to resume its construction work in Clyde which was suddenly terminated by a recent injunction. The American Telephone and Telegraph Company's lines, four miles south of Clyde, will be connected with the Empire company's exchange at Clyde.

JOHNSTOWN, PA.—A charter has recently been granted to the Somerset County Telephone Company. The new incorporation has optioned and controls the original Somerset County Telephone Company. It will at once begin work on extensions of the line to every important point in the county. Plans have been completed by which connection will be made with the Cumberland, Md., exchange.

ELMIRA, N. Y.—The New York State Telephone Company, which was recently incorporated, has filed a certificate in the county clerk's office, making the announcement that it intends to extend its lines through Buffalo, Niagara Falls, Tonawanda, Dunham, Ripley, Rouse's Point, Whitehall, Lebannon Springs and Sag Harbor. The company is now capitalized at $2,000,000. The principal offices will shortly be moved to Elmira.

BOSTON, MASS.—In a decision handed down last week by the Supreme Court, full bench, the finding of the lower court is upheld, and exceptions taken by the New England Telegraph and Telephone Company and the Boston Electric Light Company, in their joint suits against the Boston Terminal Company, are overruled. The plaintiff corporations sought to recover damages for the destruction of portions of their respective systems extending through the streets abolished when the site was cleared for the south station.

ELECTRIC LIGHTING.

VERNON, N. Y.—There is talk of the formation of a stock company to build another electric light plant in this village.

ASHLAND, PA.—The Berwick council has executed a five-year contract with the Berwick Electric Company for street lighting.

ROCHESTER, N. Y.—The Ovid electric light plant has been purchased by the Wenonah, Glassboro & Clayton Electric Company, of New Jersey.

SHELBYILLE, IND.—A citizens' heat, light and power company has been organized. The capital stock is $100,000, divided into shares of $25 each.

YORK, PA.—An ordinance has been introduced in the city council to establish a municipal electric light, power and heating plant here. The equipment will cost $35,000.

EMPORIA, KAN.—The new electric light plant, for which Emporia voted $20,000, is very near completion. The new system will include a day and night service of both light and power.

NORFOLK, VA.—The Indian River Park and Improvement Company has been chartered with a capital stock of $250,000. The company is empowered to operate gas and electric plants and electric railways.

WHEELING, W. VA.—The Moundsville Electrical Company contemplates making some extensive improvements to its system. The following officers were elected at a recent meeting of the company: C. A. Weaver, president; S. M. Steele, vice-president; H. W. Hunter, treasurer; Miss Ella Cox, secretary.

CARTHAGE, N. Y.—It is said to be a certainty that the Massena Power Company will carry electricity to Ogdensburg, Gouverneur, Antwerp and intermediate points in the future. A million dollars will be devoted to construction for the transmission of light and power to northern New York towns.

NORWALK, OHIO—The syndicate controlling the Cleveland, Elyria & Western and the Cleveland & Southern Company has purchased the Norwalk Gas and Electric Company. The Detroit United Railway Company is doing the financing, and will make many improvements to the present equipment.

MILWAUKEE, WIS.—The Northwestern Heat, Light and Power Company, which was recently incorporated, has applied to the village board of West Allis for a franchise to permit it to furnish heat, light and power in that village by means of electricity, gas, etc. It is said that the company is backed by eastern capital.

WASHINGTON, PA.—A company has been organized and will make application to the Governor of Pennsylvania for a charter under the title of the Donora Light, Heat and Power Company. As soon as the charter has been secured the company will ask the council for a franchise for the use of the streets of Donora to operate the plant.

PITTSBURG, PA.—The Southern Light and Heat Company, one of the underlying concerns of the Philadelphia Company, has purchased the plants and properties of the Ohio Valley Electric Company, of Bellevue; the Ohio Valley Electric Company, of Avalon; the Ohio Valley Electric Company, of Ben Avon, and the Ohio Valley Electric Company, of Emsworth.

PITTSBURG, PA.—The Pittsburg, McKeesport & Connellsville Railway Company has acquired the property of the Scottdale Electric Light, Heat and Power Company, and will hereafter operate it. The railway company, aside from its traction interests, is engaged in an extensive light and power development throughout the Monongahela Valley and the coking fields.

NEW HAVEN, CT.—The New York, New Haven & Hartford Railroad Company has made a contract with the Westchester Lighting Company for the lighting of the railroad company's stations from Woodlawn to Port Chester on the main line, and from Harlem River to New Rochelle on the Harlem River branch, a distance of twenty-seven miles, by electricity.

CHARLOTTE, N. C.—It is stated that a company to be known as the Bluitt's Falls Electrical Development Company will shortly be organized for the development of the power at Bluitt's Falls, on the Pee Dee River. A charter has already been granted, and everything is in such shape as to guarantee the successful outcome of the enterprise. The power developed will be transmitted to the towns of Wadesboro, Rockingham, Hamlet, Laurinburg, McColl and Bennettsville, S. C.

ELECTRICAL SECURITIES.

For several weeks following the opening of the new year the financial district evidenced a decided boom in speculative conditions. This, there was every apparent reason to believe, would be well sustained, and the growing interest which the outside public seemed about to consummate by active participation in security buying all but indicated that a very prosperous season was in order. During the past week, however, the tendency which has been growing toward a decided apathy on the part of speculation in general, and particularly on the part of the outside public, has become very evident. Unless there is some very large development, this condition of apathy will prevail for some little time. The continued unsettled state of the Venezuelan affair is attracting no little attention in financial circles, and the outcome to-day appears to be further away from a definite and amicable settlement than the early course of events would seem to predicate.

The declaring unconstitutional of certain sections of the Ford franchise tax law was not without its general effect. There were no upset conditions prevailing, however, because the result in detail was more or less anticipated. Then, again, the conditions which these decisions might have relieved somewhat are still depressed by the introduction of new measures in the legislature, and the very apparent certainty that these properties or rights will be eventually forced to pay taxes.

New York:	*Closing.*
Brooklyn Rapid Transit	67⅜
Consolidated Gas	216
General Electric	187
Kings County Electric	218
Manhattan Elevated	150½
Metropolitan Street Railway	138¾
New York & New Jersey Telephone	163
Westinghouse Manufacturing Company	215

The stock of the General Electric Company made a gain of 6¼ points on Monday, January 26, selling as high as 193¼. This was attributed to the alleged completion of a deal between the company and the Whitney-Widener-Elkins syndicate, whereby the General Electric Company secures the Stanley Electric Company and some agreement regarding the Electric Storage Battery Company. There is no doubt but that there is a tendency of these large interests to effect a consolidation, but up to date these statements are without official confirmation. As stated in the ELECTRICAL REVIEW some weeks since, if such a deal is consummated it is probable that each of the organizations will be operated, as heretofore, as independent interests.

A special meeting of the Commercial Cable stockholders has been called for March 2, to vote on the proposition of increasing the capital stock of the company from $15,000,000 to $25,000,000.

Notice has been given that the stockholders of the Manhattan Railway Company have voted to increase the capital stock of the company from $48,000,000 to $60,000,000, stockholders of record at the closing of the transfer books on January 27 being entitled to subscribe for $7,200,000 of such increased capital stock at par, to an amount equal to fifteen per cent of their respective holdings.

The gross earnings of the Brooklyn Rapid Transit Company for the month of December amounted to $1,076,192, an increase of $38,034 over the corresponding month of 1901.

The annual report of the American District Telegraph Company for the year ended December 31, 1902, shows the outstanding capital stock to be unchanged at $3,844,700. Of this amount $5,500 is in the treasury. Comparing the income account, the revenue from all sources for 1901 is $624,192; for 1902, $610,043, a decrease of $14,149. For general expenses, maintenance and construction, the total for 1901 was $535,544, and for 1902, $513,176, a decrease of $22,368, making an increase in the net revenue of $8,219.

Boston:	*Closing.*
American Telephone and Telegraph	162
Edison Electric Illuminating	279
Massachusetts Electric preferred	94
New England Telephone	136
Western Telephone & Telegraph preferred	98½

The Western Telephone and Telegraph Company has declared a regular semi-annual dividend of $2 a share on the preferred stock, payable February 2 to stock of record January 22. Books close January 23 to February, both inclusive.

Philadelphia:	*Closing.*
Electric Company of America	9⅜
Electric Storage Battery common	78
Electric Storage Battery preferred	80
Philadelphia Electric	8¼
Union Traction	46⅞
United Gas Improvement	111

Chicago:	*Closing.*
Chicago Edison Light	180
Chicago Telephone	156
Metropolitan Elevated preferred	86
National Carbon common	26
National Carbon preferred	96
Union Traction common	12
Union Traction preferred	47

West Chicago Street Railway has declared the regular quarterly dividend of 1½ per cent, guaranteed by Union Traction Company, payable February 15. Books close February 5.

The gross earnings of the Chicago Telephone Company for the year 1902 amount to $4,570,805, as against $3,775,001 for the year 1901, a gain of $795,804. Net earnings are $1,202,471, a gain of $118,599 over 1901.

ELECTRIC RAILWAYS.

BALTIMORE, MD.—A trolley line will be built from Salem to Adamstown, W. Va., where it will connect with the Clarksburg & Fairmont Electric Railway.

PORT CLINTON, OHIO—A fifty-mile electric line, to extend to the summer resorts of Lake Erie from Toledo eastward, and to cost $850,000, will be built in the near future.

MONESSEN, PA.—Monessen is to be connected with Uniontown by an electric street railway. The company financed by Pittsburg, Uniontown, Scottdale and Monessen capitalists has decided to extend its line from Webster, the northern terminus, through the more thickly populated coal settlements of Westmoreland and Fayette counties.

AUTOMOBILE NOTE.

AMERICAN AUTOMOBILE ASSOCIATION—The first annual meeting of the American Automobile Association was held at the headquarters of the association, No. 753 Fifth avenue, New York city, on January 20. President Scarritt opened the meeting with an address congratulatory of the splendid progress made in the automobile industry during the year just closed, and made an appeal for the members to stand together and perfect a broad national organization for the protection and furtherance of the sport and industry. The reports of the secretary and treasurer were read and approved, showing the association to be in good financial condition. The racing committee recommended some extensive changes in the racing rules in reference to classification, and proper rules and regulations for track and road racing. Mr. Jefferson Seligman presented the report of the legislative committee, covering the regulation which had been secured from the Treasury Department in regard to free entry into the United States of automobilists, tourists from abroad, for a period not exceeding three months under bond. The question of what constituted a professional or an amateur was referred to the board of directors for determination. The following officers were unanimously elected: President, Dr. Julian A. Chase, Rhode Island Automobile Club; first vice-president, Honore Palmer, Chicago Automobile Club; second vice-president, E. Schryver Reese, Cleveland Automobile Club; third vice-president, Charles E. Judd, Grand Rapids Automobile Club; treasurer, Howland W. Whipple, Automobile Club of America; secretary, S. M. Butler, Automobile Club of America; directors, W. E. Scarritt, Frank G. Webb, Dr. Millbank, William J. Stewart, Frank C. Lewin, Max C. Fleischmann and A. R. Pardington.

LEGAL NOTE.

GENERAL ELECTRIC COMPANY GETS DECISION—A decision has just been handed down by Judge Ray in the suit brought by the General Electric Company against J. B. Wise, of Watertown, N. Y., on the Tournier patent, No. 559,232, April 28, 1896, incandescent lamp socket, declaring that the patent is valid and infringed by the defendant's device, which is an Edison type lamp socket; and an order for an injunction has been issued, restraining the defendant from manufacturing any more such sockets.

INDUSTRIAL ITEMS.

EUGENE C. LEWIS COMPANY, bookbinder, 202 William street, New York city, has a number of friends in the electrical fraternity. The company is sending to its patrons a very attractive and useful calendar pad.

BANNER ELECTRIC COMPANY, Youngstown, Ohio, in addition to manufacturing the well-known type of "Banner" incandescent lamps, is also producing an additional line of electrical apparatus such as time switches, panel-boards and other specialties.

J. G. WHITE & COMPANY, LIMITED, 22a College Hill, E. C., London, has had a most successful year's operation. The profit and loss account shows well on the side of the company. The New York office of J. G. White & Company is at 29 Broadway.

SARGENT, CONANT & COMPANY, Boston, Mass., will entirely rewire the Equitable Building, Boston, which was partially destroyed by fire on January 9. Sargent, Conant & Company had a crew of men at work making temporary connections within twenty minutes after the fire was under control.

S. G. BOOKER, 405 Fullerton Building, St. Louis, Mo., has been given the local agency in that vicinity for the C. J. Toerring Company, Philadelphia, manufacturer of arc lamps; the Brilliant Electric Company, manufacturer of incandescent lamps, and also William Roche, New York, manufacturer of dry batteries.

THE ELECTRIC STORAGE BATTERY COMPANY, New York city, recently opened a new Exide battery depot in Rochester, N. Y. Although an Exide battery station is located at Buffalo, owing to the increasing use of electric vehicles in this portion of New York state, the opening of the above office has been found necessary. It is located at the establishment of J. J. Mandery, 157 South avenue, Rochester.

THE GRATON & KNIGHT MANUFACTURING COMPANY will be pleased to send to interested parties a sample belt for testing purposes. The company has such great confidence in its "Royal Worcester" and "Heart" brands of belts, that it is satisfied that none of these will be returned as unsatisfactory, once being given a trial. Full particulars with regard to this offer will be promptly forwarded upon request to the company at Worcester, Mass.

THE ECCLESTON LUMBER COMPANY, 29 Broadway, New York city, announces that it has on hand a larger number of seasoned poles and lumber for electric line construction work than at any period in its history. This is in order to supply the greatly increased demand for this company's material. The company plans to further increase its stock facilities in order to anticipate several heavy contracts which are about to be closed.

THE JOSEPH DIXON CRUCIBLE COMPANY, Jersey City, N. J., has on the market a complete line of graphite lubricants for every degree of service. The company makes a special form of graphite lubricant for automobile bearings and is in receipt of a number of gratifying testimonials from automobile operators. A very attractive booklet entitled "A Toot for Dixon's Graphite" explains the different forms of graphite designated for automobile lubrications, and gives some valuable information as to the proper care of these parts.

THE AUTOMATIC ELECTRIC COMPANY, Chicago, Ill., is installing a new automatic switchboard for the Automatic Telephone Company, of Princeton, N. J. A number of years ago, the Princeton company entered the telephone field with an automatic switchboard and twelve stations connected up. The service grew in public favor until the ultimate capacity of the board, which was 100 stations, was exhausted. This has resulted in the management giving the manufacturers an order for an entirely new outfit, the initial installment being 150 telephones.

THE PEDRICK & AYER COMPANY, located for some time at Philadelphia, Pa., has removed to Plainfield, N. J., where it is now occupying the new works which has just been completed. The main building is 400 feet long and 100 feet wide, with independent powerhouse, blacksmith shop, pattern shop and pattern storage. This new shop is equipped with electric traveling cranes and modern tools, to enable the company to meet a largely increased demand for standard goods, consisting of air compressors, air hoists, pneumatic riveters and special railroad tools. The company's selling office is at 85 and 89 Liberty street, New York city.

JAMES L. ROBERTSON & SONS, 204 Fulton street, New York city, are the manufacturers of "Eureka" packing for steam engineering. Eureka packing is made of loose fibres of long flax, twisted in cords. These cords are then twisted into what are called "roves." These are then braided closely around a rubber core which has been vulcanized to such a degree that it retains its resiliency, being affected neither by heat nor cold. Several layers of the flax are braided around this rubber core, each layer being separated by a special lubricant. The company also manufactures a number of engineering specialties which have become very popular under severe service, and is in possession of numerous testimonials as to the reliability of its product.

G. M. GEST, New York city, and Cincinnati, Ohio, has been more than usually successful in securing a number of large contracts for conduit construction this past season. The Gest conduits are now being equipped with the conduit terminal for finishing in a very complete manner manholes and conduit ends. The Gest conduit terminal is so shaped that the conduit end butts into a flange deep enough to afford a snug fit, the outside of the terminal being flared so as to receive a deep bedding of cement, so that the brick course can come up flush with the face of the terminal. These terminals are made either of cast iron, with enameled surfaces, or of glass or porcelain. Descriptive circulars will be sent on request to any one interested.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, Pittsburg, Pa., has recently sold to the Susquehanna Iron and Steel Company, of Columbia, Pa., which is about to install an electrical power distribution plant in its mills, a 400-kilowatt, alternating-current generator, one 200-horse-power induction motor, and about 400 horse-power in motors ranging in size from 50 horse-power to 20 horse-power. The Westinghouse company is also equipping with electrical apparatus for power distribution the Anaconda Copper Mining Company's works. This is to work a 5,000-ton per day reduction plant. The contract embraces seven motors of an aggregate of 185 horse-power, to be added to the present installation of thirty Westinghouse motors of an aggregate of over 1,000 horse-power.

THE WESTERN ELECTRIC COMPANY, Chicago, New York, St. Louis and Philadelphia, has been unusually successful in placing in operation a very complete line of motors for machine tool work. The handsome new bulletin No. 3010, entitled "Power Motors," is of great interest to any one who may be interested in this very important development of the application of electric power. The bulletin describes several forms of encased and semi-encased machines, slow and intermediate speed motors and dynamos, open-type multipolar machines, elevator motors, back-geared motors, back-geared incased motors, and gives a great deal of valuable information as to construction, application and the use of accessories. Besides diagram drawings showing dimensions, there are a number of half-tone reproductions of motor applications in typical and special service. On the whole, the bulletin is remarkably well handled and the company is to be congratulated for its completeness.

THE STANLEY ELECTRIC MANUFACTURING COMPANY, Pittsfield, Mass., as intimated in last week's issue, has made substantial preparations for putting on the market a high-potential railway system employing electric locomotives using current directly without the intermediary of rotary converters or transformers. This means the running of long-distance, heavy, high-speed trains, with stations from fifty to seventy-five miles apart. The control wires will be carried along the track, so that steam locomotives can be used without interfering with the electric system. No substation arrangements whatever will be used—simply powerhouses located from fifty to seventy-five miles apart, with control wires connecting them. While the locomotives, it is stated, will be more expensive than any built on present schemes of equipment, the saving in copper for distribution will compensate for this increased cost of apparatus. This system is the result of work of the Stanley company's engineers on patents under which the company has secured rights from engineers in this country and abroad, the plan being made possible by this combination, and to an entirely new form of dynamo with a new form of motor control, permitting the use of high voltages directly on the car, and absorbing no energy in resistance.